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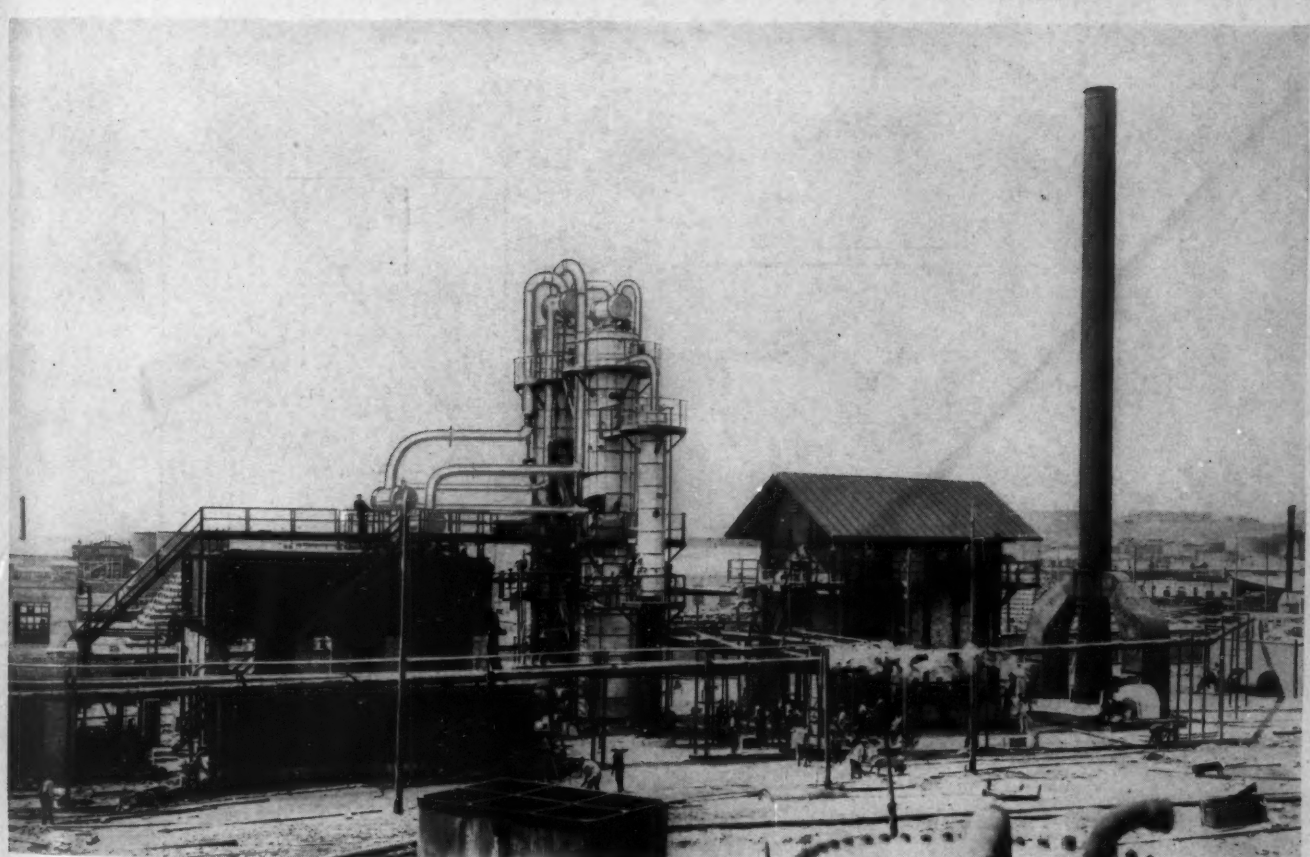

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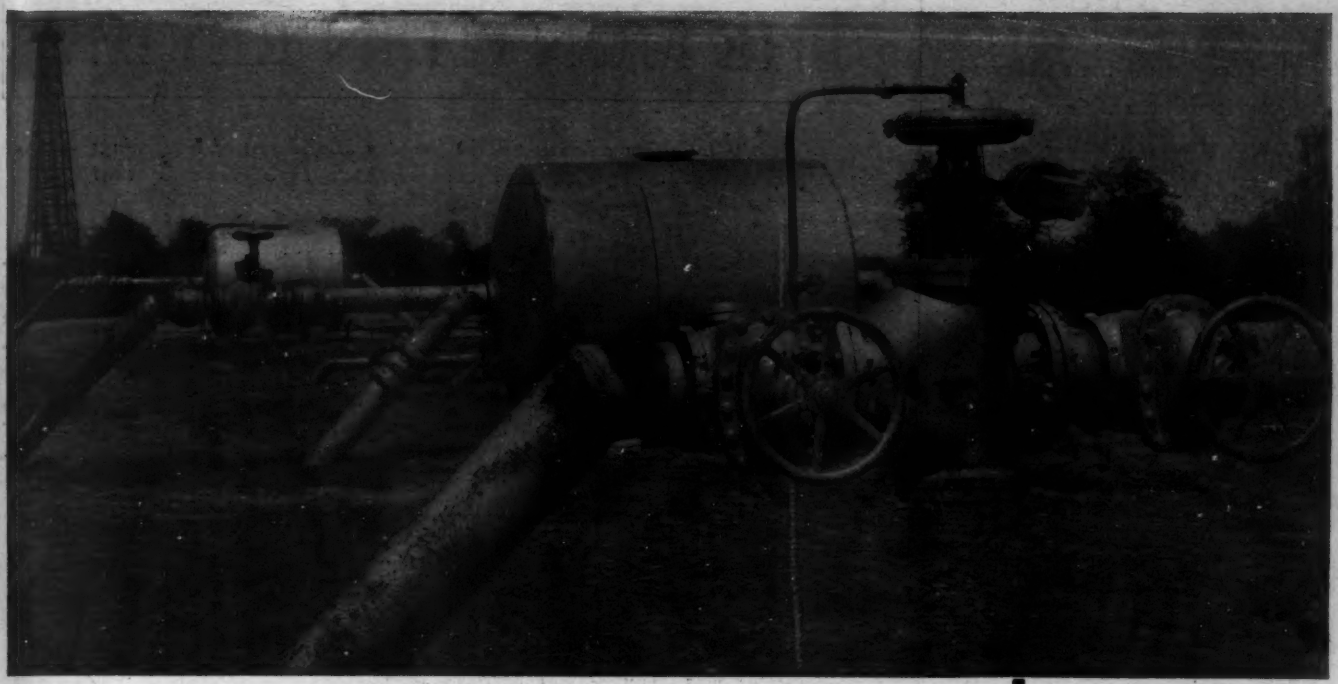

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THE MONTH IN REVIEW

In the following columns will be found a brief digest of happenings of interest to refiners, with even reference to a rumor or two!

IMPORTS of petroleum into the United States during April totaled 7,131,000 barrels, more than a million barrels than for March when the total was 8,518,000 barrels. Gasoline imports for the two months were, April 1,073,000 barrels, March 1,279,000 barrels; crude oil, April 4,622,000, March 8,518,000 barrels. Bulk of the remainder was fuel oil. Ninety per cent of the imports are at Atlantic ports.

CRUDE oil production in the United States was about 23,000 barrels per day more in April than for the previous month, according to preliminary figures based on estimates announced by the American Petroleum Institute. However, a difference in days gives the former month a greater grand total, the comparative figures being 74,658,700 barrels in April as against 77,317,050 barrels in March. Texas, Arkansas and California showed losses in crude recovery while all other sections were showing slight increases. Co-operative efforts of producers to curtail output is responsible for a decided drop in production since January, but economists still see danger in the rate of production, pointing out that too much oil is in stock for current production to even balance current demand.

NEW wells completed during April numbered 1702, of which 1023 were oil wells, as compared with 1544 completions and 794 oil wells in March. These figures reveal more drilling in April than for the same month a year ago. So far this year there have been 6627 wells completed* of which 3840 wells produced oil. In the meantime 4785 new wells were started, which is 170 behind the total for the first four months of 1929—4955 new wells. The new well figures do not include statistics on Eastern and Mountain States.

*Data on Mountain States omitted.

GASOLINE Consumption in 43 states for February, 1930, as indicated by reports made by wholesalers and dealers in the various states, under provisions of the gasoline tax laws or gasoline inspection laws, totaled 665,500,000 gallons, compared with 553,725,000 gallons in February, 1929, an increase of 111,775,000 gallons, or 20.2 per cent. Daily average consumption for February, 1930, was 23,768,000 gallons, compared with a daily average of 21,570,000 gallons in January, 1930, an increase in daily average during February of 10.2 per cent. Gasoline consumption in these 43 states for the two months ending with February, 1930, amounted to 1,334,175,000 gallons, compared with 1,164,336,000 gallons for the corresponding period of 1929, an increase of 169,839,000 gallons, or 14.6 per cent.

CRUDE price changes during April included slight advances—four to 13½ cents—in Texas, Oklahoma and Kansas; Louisiana and Arkansas, up 10 to 13 cents, and scattering advances in Central and Mountain States. Late in the month came a reversal when all Pennsylvania grades were reduced 25 cents per barrel. Movement of oil to Eastern plants from outside in greater volume has been assigned as a reason by unofficial sources, and some weight may have been exerted by the inauguration of an advertising campaign by one national distributor of lubricating oil to the effect that "manufacture and not source of the crude determines the quality of lubricants." This method of attack has been long in coming, and should be interesting in the event the campaign is kept up and joined by other makers of lubricating oils not claiming Pennsylvania origin.

CALIFORNIA'S efforts to bring oil supply down to demand has resulted in a committee which has under consideration a balanced program of production and refining extending over a period of nearly three years. Basing its calculations on economic principles, this committee has divided stocks into three groups: fuel oil and gas oil; refinable oil, and gasoline. California has had two years of serious over-production and recent efforts to reduce output of wells have not been completely effective, although production has been brought down from around 800,000 barrels daily to 625,000 barrels daily—still above the 603,000-barrel mark recently set as the proper figure to induce stabilization. Two or three fields in the state are ready to start

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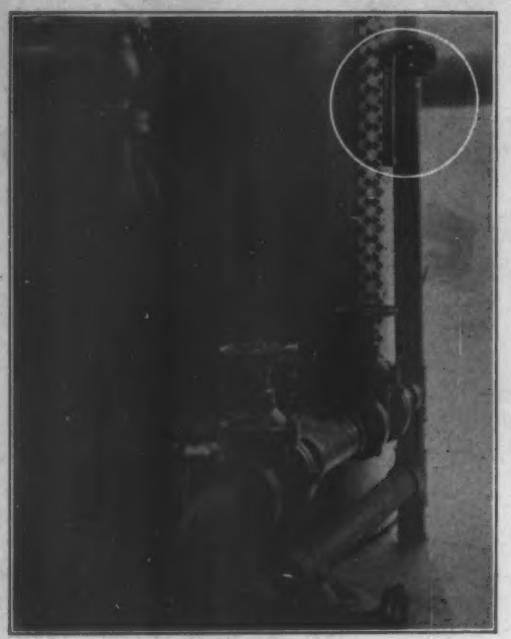

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are extensively used by Refiners and Natural Gasoline Manufacturers for checking and balancing oil and gas flows.

The Direct Reading Scales calibrated to suit the individual requirements, in barrels per hour, cu. ft. per minute, etc.; coupled with the *Compact Design* and *Proven Reliability* makes these Indicators indispensable for efficient plant operation, . . . And the cost is reasonable.

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The Month in Review

trouble at a moments notice, while the famous gas conservation law is still inoperative under court action and is a bar to harmony among operators. Operators in the Western state talk a lot about controlling well flow but the only voice of authority seems to be money—when the posted price of crude is fluctuated it immediately reflects in well flow. Gasoline prices out there seem harder to handle.

OPTIMISTIC over their future, natural gas men gathered at New Orleans on May 6 (annual meeting of the Natural Gas Department of the American Gas Association) talked about rapid strides they have made and are making in giving national distribution to natural gas. Strides have been greatest in the Southwest and on the Pacific Coast, and now there is talk of making the natural fuel available for New York City, the principal cities in the Middle West already having been provided for. This gas expansion has a great economic effect upon the oil business—providing as it does the one fuel superior to oil in domestic heating and for industries where coal competition will permit. As more gas is distributed the demand for fuel oil declines, as does the market for oil used in the manufacture of artificial gas. As compensation, the oil industry holds most of the gas producing properties.

CONTINUATION of the fight for a tariff on imports of crude and refined petroleum and determined efforts toward the restriction of activities in the United States of foreign-controlled oil companies are the two major objectives of the Independent Petroleum Association of America, it was revealed at the association's first annual meeting at Fort Worth, April 18 and 19. The association was formed in June, 1929, as an aftermath of the conservation meeting called by President Hoover at Colorado Springs. Mark L. Requa, reputed spokesman for the president, was "misunderstood" in language from which it was inferred that oil men were asked to do willingly what the government might force them to do in conserving petroleum resources. Wirt Franklin of Ardmore, Oklahoma, organized the association and is still its president after a spectacular and unsuccessful fight in Washington for a tariff on oil. The organization now includes vice presidents representing every oil producing state and a board of directors including many substantial independent operators

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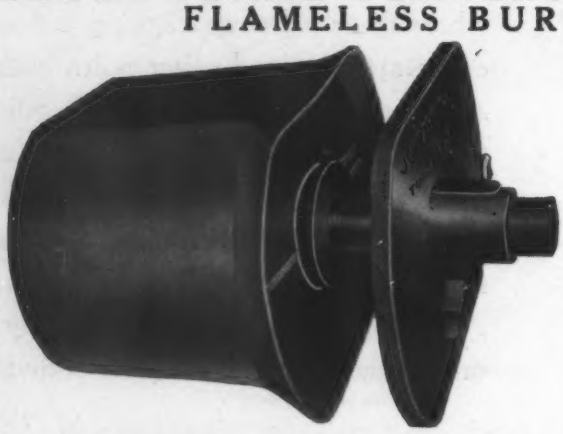

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Burns Rectifying column and Still gases with a short flame.

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The Month in Review

of the Mid-Continent area. The association favors $1.00 per barrel on crude imports and 50 per cent ad valorem on refined oils. The ire of the meeting was particularly aroused to opposition to foreign owned companies operating in the United States by a statement quoted from Sir Henri Deterding of Royal Dutch Shell, to the effect that "in modern business the small oil producer cannot exist. This may not be fair, but it cannot be helped. The larger companies are competent to serve the public economically."

ONE of the latest merger rumors involves negotiations said to be under way between Transcontinental Oil Company and Ohio Oil Company. The report in fianncial circles is that the merger would be on an exchange of stock basis, three shares of the former for one of the latter. The two companies jointly own important productive acreage in the Yates pool, West Texas, Ohio Oil Company, through its subsidiary, Mid-Kansas Oil & Gas Company, operating with Transcontinental Oil Company on leases that are undivided. Ohio Oil Company's subsidiary, Illinois Pipe Line Company, handles the production. The arrangement was brought up for court consideration a number of months ago when Transcontinental Oil Company proposed to build a pipe line to the Houston Ship Channel and handle its own share of the Yates oil. Result was that Mid-Kansas Oil & Gas Company was sustained in its contention that the operating agreement was that it should market the production from the joint holdings. Meanwhile Transcontinental Oil Company had negotiated for acreage upon which to build a refinery on Gulf tidewater.

THE Texas Company is now offering Ethyl gasoline through its stations and dealers in every state in the United States. This company heretofore has had no premium grade of gasoline but marketed "New and Better Texaco" with a lower than U. S. Motor end point and an anti-knock rating which proposed to compete with premium grades and regular prices. Installation of pumps and tanks to handle the new grade involved one of the largest extensions of marketing facilities in many months. Meanwhile Gulf Refining Company is marketing a new gasoline at competitive price which has the general characteistics of the fuel featured by The Texas Company previous to adoption of Ethyl. Gulf Refining Company's "high test" fuel is still offering competition to Ethylized gaso-

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Install OCECO VENT UNITS — for protection against fire — and worry.

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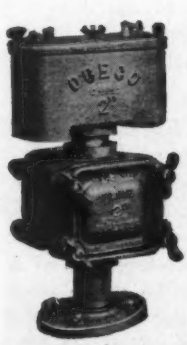

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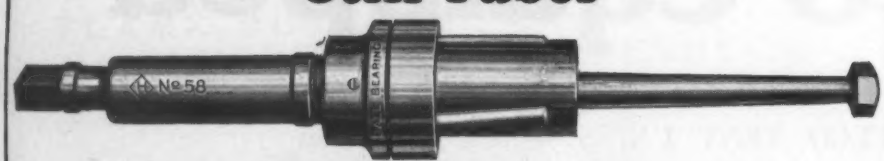

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The Month in Review

lines. And speaking of Ethyl, it is interesting to note that the fluid resulted from research by General Motors Corporation and is manufactured and marketed by a company owned 50-50 with Standard Oil Company of New Jersey—Ethyl Gasoline Corporation having headquarters in the Chrysler Building in New York. First believed by many refiners and marketers to be an alliance between the biggest motor maker and the biggest oil company to corner fuel for high compression motors, it has developed that Ethyl fluid is available to everybody with no restrictions on territory.

FORMATION of Philokla Gas Company has been announced by Phillips Petroleum Company. The new concern is a partnership between this concern and the Oklahoma Natural Gas Company. Philokla Gas Company will operate a compressor station in the Oklahoma City pool. Gas, after passing through the plants of Phillips Petroleum Company in that field, will be put through this compressor station and its pressure raised to a required point. Then it will be sold to oil producers who may desire to use gas-lift in raising oil after the wells have ceased flowing. Gas not used in this manner will be put into the distributing system of Oklahoma Natural Gas Company for domestic and commercial sale.

AMERICAN Petroleum Institute has circularized its members requesting that those interested write to New York headquarters for copies of "International Trade in Petroleum and Its Products," soon to be published by the Department of Commerce. It is pointed out that some members are not interested in this data and expense of distribution will be lessened by sending only those copies which will be used.

*ANNOUNCEMENT by Stand-*ard Oil Company of California that it will purchase gasoline for export, delivered at ship's rail, San Pedro, California, at 6½ cents per gallon was one of the most important developments of the year and is expected to be a stabilizing factor in both the gasoline and crude oil markets. This was the first official posting of gasoline prices ever made and is an innovation which may be followed by leading purchasing companies in other districts. The offer specifies a 30-day period and is subject to change without notice. It applies specifically to U. S. motor gasoline but states that prices for other grades will be quoted upon application. Large quantities of gasoline have left Los Angeles harbor at six cents per

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Specialization

Heat exchanger equipment of today must be designed by specialists.

Your heat exchanger should be designed to fill your particular requirements efficiently and economically.

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Holding Back 800 lbs.

while continuously delivering only 10— Is That What You Want to Do?

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—or to discharge intermittently into especially low pressure or very high pressure distributing systems.

That's the field of service the C-F BACK PRESSURE REGULATOR is expressly made to cover. And cover it, it does, to perfection—and to the general satisfaction of the gasoline manufacturing industry.

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CF *BACK PRESSURE* REGULATOR

(Pilot Valve Type for High Inlet Pressure)

The Month in Review

gallon, and even less, with the net-back not more than meeting cost of manufacture. The new policy will stabilize the export market and insure refiners at least the cost of manufacture for their products.

ASSOCIATED Petroleum Economist, G. R. Hopkins and Statistical Clerk, E. W. Cochrane, U. S. Bureau of Mines, have completed their 1930 Information Circular No. 6292, "Petroleum Refineries in the United States" Jan. 1, 1930, and it is now available from the Bureau.

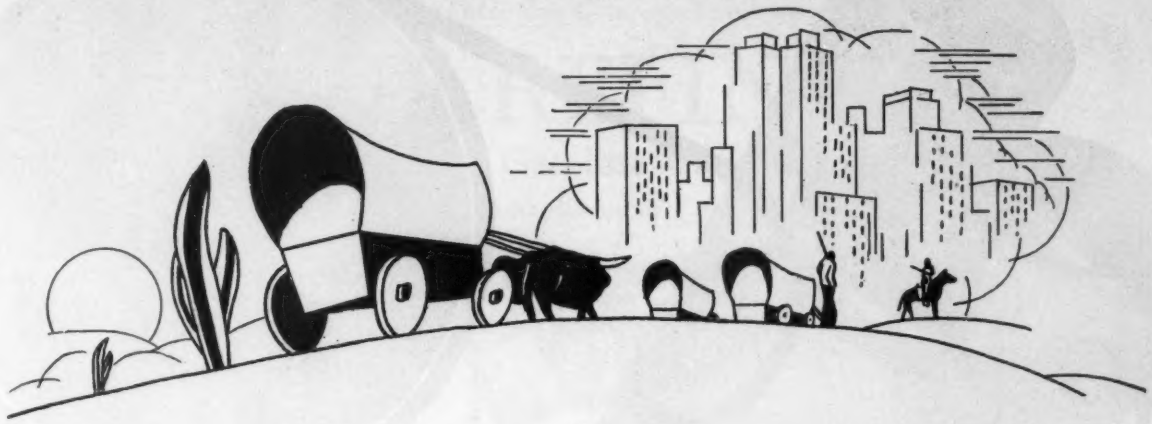
This work indicates that on January 1, the status of the industry was as follows:

Operating refineries	358—
Shut down refineries	54—
Building refineries	8—
Total	420
	Barrels
total capacity operating	3,634,825
total capacity shut down	130,760
total capacity building	37,200
Total	3,802,785

In regard to cracking the authors state "Of the total number of completed building plants 201 possessed cracking equipment which had a total charging capacity of 1,673,940 barrels per day. In addition there were 4 cracking plants not connected with a refinery which had a total charging capacity of 35,000 barrels. Thus the total charging capacity of the cracking plants on Jan. 1, 1930, amounted to 1,708,940 barrels as compared with 1,476,874 barrels the previous year, a gain of 16 per cent."

These figures agree nicely with the annual survey of cracking as presented in The Refiner and Natural Gasoline Manufacturer July, 1929, pages 61-63, in which all construction work was included and which indicated a cracking capacity for this country of 1,773,200 barrels upon completion of installations then underway. Some of the work then reported was not completed on Jan. 1, 1930, notably the large expansion program of the Gulf Refining Company which alone was adding 22 cracking units. A casual study of expansion of cracking facilities at this time indicates that the cracking capacity of the refining industry will reach the 2,000,000 barrel mark during the current year. It is also indicated that 20 refining companies will possess about 80 per cent of this cracking capacity. Complete details of cracking equipment by companies as of Jan. 1, 1930, will be published shortly by the Bureau of Mines.

"Pioneers lead the way to achievement"



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VOL. 9, No. 5 MAY, 1930

GRADY TRIPLETT, *Editor* GEORGE REID, *Associate Editor*

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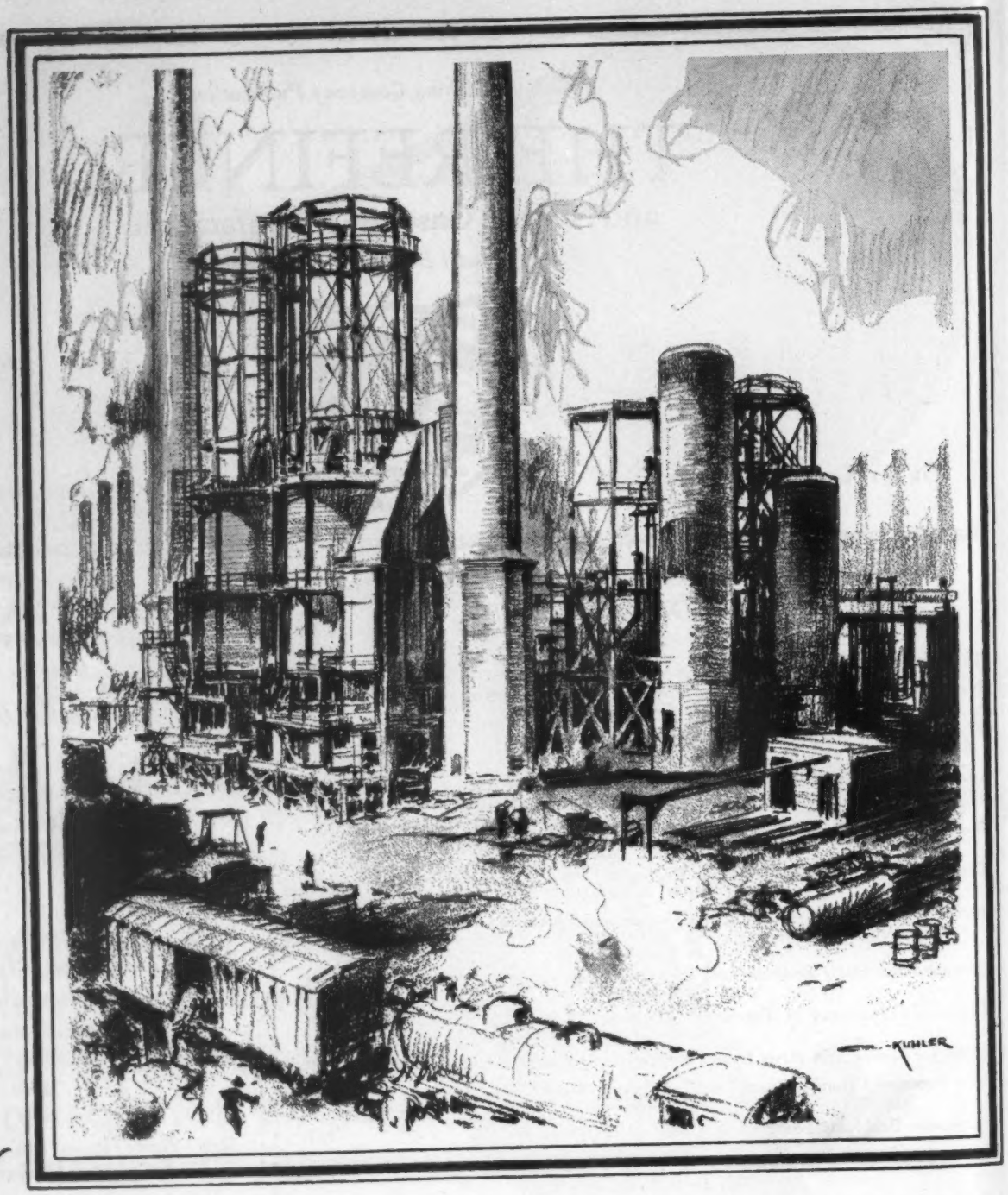

Kellogg MEETS THE EXACTING DEMAND FOR GREATER ECONOMY IN PROCESSING

Based upon laboratory studies of the charging stock, each Kellogg design for refinery equipment is sound in principle, and planned for maximum thruput. Added to this is the value of high-grade materials and workmanship—providing the satisfaction and economy of unfailing performance.

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"Naturals" Blending Bases, and the Physical Laws of Solution

By GEORGE REID
Associate Editor

THE advent of premium grades of motor fuels, especially during the colder months when volatility as well as power performance are required by motorists, has necessitated much research and experimenting in the admixture of petroleum distillates with the condensates extracted from natural gas. Much of this work has been done from the standpoint of determining what quantities or proportions of natural gasolines of given types may be blended with refinery distillates. The principle effect of dissemination of information secured through such experiments seemingly has been to arouse the interest of the refiner, who is the major blender, and who in turn has apparently assumed what might be termed a defensive attitude in that his interpretation of the overtures of the gasoline manufacturer is that refiners should blend in greater proportions of "naturals."

Despite the great amount of valuable work done by the natural gasoline manufacturers through their research program, the refiner is not sold on the use of naturals up to 40 and 60 per cent, nor is he convinced that his anti-knock values are materially increased through the use of naturals. Refiners have not yet extensively accepted the commendable practice of blending to volatility as against gravity, although present indications point to its early acceptance.

The refining industry has apparently neglected to study the scientific preparation of blending bases derived from their petroleum distillates. Insofar as the majority of scientific endeavor has progressed toward the preparation of constantly uniform motor fuels, such work, apparently, has been for the most part confined to motor fuels direct from crude stills and cracking units and to the exclusion of natural gasoline except as a medium for raising gravity to meet popular so-called "high test" specifications. There are, of course, many refiners blending for volatility and balance and therefore giving proper consideration to the production of blending bases designed for the solution of larger percentages of naturals, which latter are usually prepared by the same companies for the most part. As a general rule, however, among refiners the term "jake-up" still applies to their blending operations.

In The Refiner and Natural Gasoline Manufacturer, issue of April, 1923, page 14, the writer discussed the fundamental principles of blending and the application of certain physical laws governing the preparation of solutions amphasizing the influence of lighter distillates and their tendency to lower boiling points of heavier refinery distillates. At that time there was much discussion among refiners as to whether certain physical changes in distillates when blended with natural gas condensates were chemical or purely physical changes, and further, whether it was possible or not to lower 10, 20, 50 and 90 per cent boiling points and final boiling points of a petroleum distillate through the simple addition of various proportions of natural gasoline.

A series of some hundreds of experiments in blending natural gasolines of different physical properties with one, two, or more, petroleum distillates was carried out over a period of a year to determine the influence of one set of physical properties upon another combination of physical properties when solutions of varying proportions were prepared to meet the then current motor fuel specifications. The results of this work were published in the article mentioned above.

SOLUTION AND BLENDING

In the preparation of petroleum distillates for use as blending bases when blending is carried out either for the purpose of consuming company owned natural gasoline production, for profit when market conditions are

such that this is possible, or for volatility and balance in a finished premium grade motor fuel, it is well to remember that certain physical laws govern the blending process, and that blending is essentially the preparation of a more complex solution through the admixture of two or more other complex solutions.

Solution may be termed a mixture in certain cases and especially where liquids are involved. A mechanical mixture, for differentiation, is essentially a collection of substances, either elements or compounds, which retain their original chemical identity and which may be separated by physical methods. In refining the method of separation or "un-mixing" is fractional distillation. Solutions, therefore, of petroleum distillates are merely and purely mechanical mixtures. In solutions of complex solutions the physical properties originally identifying each of the components are lost and a new set of properties replace them.

To put it differently, in solutions or mixtures of petroleum distillates there is no change within the molecule. In preparing solutions of distillates from crude and condensates from natural gas, one with the other or others, the molecular attractions called cohesion and adhesion peculiar to each component are overcome or adjusted. This, by the way, accounts for the evolution of heat noticeable when preparing solutions. The molecules of each component merely move aside, so to speak, to allow molecules of the solute room or space enough so as to mingle in intimate contact. The invading solute is given room for its peculiar molecules to mix with those molecular particles of the solvent liquid.

After completion of the mixing the forces of cohesion and adhesion are still in effect; however, the force exerting itself, or the attraction of one molecule for another is that of the solution as a distinct and different substance, not chemically different, but physically different, i.e. specific gravity, boiling range, color, and the like. This covers the phenomena evidenced when solutions are prepared of liquids composed of chemical members of homologous series.

The application of heat is conducive to acceleration of solution because the expansion of the liquid loosens the molecular intimacy, weakening the forces of cohesion and adhesion and thus hastening the reception of solute by solvent. Blending therefore, in the vapor state would give quicker and more uniform results, possibly, but such practice is usually commercially impractical. Liquid state blending when properly carried out with specially selected or prepared petroleum distillates and natural gas gasolines yields equally uniform products and is the cheaper method of preparation.

PHYSICAL LAWS

Physical properties inherent in original distillates disappear upon solution or mixing for the resultant blend becomes technically a homogeneous mixture of substances forming a single phase. The evolution of heat resulting from this molecular intermixing is academically known as the heat of solution or dilution, and by carefully recording temperatures occurring in blending distillates with condensates there is generally noticed a perceptible rise in temperature. Usually, however, under plant conditions the natural gas gasoline is much colder than petroleum distillates and the indications point to merely an equalization of temperatures.

The singular solution prepared as blends indicate by their vapor pressure curves a maximum and minimum solubility. Wuelners' law elucidates this statement: "The lowering of the vapor pressure of a solvent is approximately proportional to the quantity of solute dissolved in it if the quantity of solute be very small." Exemplyfying this law by experimentation it was indicated that a certain refinery distillate would "absord" or dissolve up to four per cent by volume of a selected natural gas gasoline before the initial boiling point is depressed and begins lowering.

Within very definite limits the initial boiling point of natural gas gasoline will be raised when it is mixed with refined distillates, but will suffer a marked depression of initial boiling point upon a further increase in the proportions of the light natural gasoline.

Bladgen's law further augments this fact, viz: "The depression of the freezing point or increase in boiling point of a solution is for small concentrations proportional to the amount of the dissolved substance." The two physical laws of Wuelner and Bladgen govern the amount of natural gasoline which may be blended with petroleum distillates insofar as given properties such as initial boiling points, are concerned, and they may be likewise applied to a certain extent to the raising or lowering of boiling points of certain fractions such as the 10, 20, 50 and 90 per cent points. The distillate from crude being used as solvent may dissolve 15 per cent by volume, or 25 per cent by volume of a given grade of natural gasoline of selected physical properties, but the addition of one per cent more of the light condensate will result in a depressed boiling point and throw the finished blend off initial and total recovery specifications.

It is because of these facts that blending bases made from petroleum distillates should be carefully prepared and after such preparation of the solvent distillate such natural gasolines as are known to give the desired results in uniformity and balance of finished blend, should be purchased. Through judicious handling of refinery distillates the recovery of which is designed to secure the maximum yield from the crude process, it is possible to blend high mileage, uniform and balanced motor fuels by the admixture of predetermined amounts of natural gasoline of a specified type and composition. A thorough knowledge of the composition of the natural gasoline is just as important as a thorough knowledge of the refinery product. It is often the case that carefully prepared blending stocks consisting of different proportions of two or more refinery products are ruined when blending because of a change

in the boiling or vapor pressure characteristics of naturals shipped to the refinery from various sections.

The law of LeChatelier states: "If a system in physical or chemical equilibrium be subjected to a stress involving change in temperature, pressure, concentration, or similar stress, the state of the system will automatically tend to alter, so as to minimize the effect of the stress." The working of this law is evidenced by the very rapid evaporation occurring where blends are charged too highly of natural gasoline, as the vapor pressure alters itself to minimize the stress within itself.

D. B. Dow, in Serial 2279, Bureau of Mines, September, 1921, calls attention to the effect of naphtha as blended with natural gas gasoline, wherein the vapor pressure is materially lowered by small quantities of the heavier distillate. This is an example of the working of Wuelner's law, previously cited. With the advent of such improvements as high pressure stabilizing equipment, however, the necessity of blending naphtha with naturals for the purpose of reducing vapor pressure has been precluded. The present day stable grades of gasoline, on the other hand, are not so freely used in the preparation of premium gasolines as would be expected although they are possessed of inherent characteristics which permit their employment in much larger proportions than the former eight to 10 per cent. In the present work of the Natural Gasoline Association toward the adoption of specifications for natural gasolines which may be interpreted in terms of the components of the products there is found reason to believe that refiners may make larger use of the products of a sister industry.

BASES FOR BLENDING

The refiner has improved his distillates produced for blending purposes by the installation of very efficient fractionating equipment, and the refinery which must utilize natural gasolines produced by a separate department of his company, may easily regulate modern fractionating equipment at his plant to produce blending bases ideally suited for the solution of that natural gasoline which he must use in much larger proportions than is at present generally practiced.

The distillate prepared for blending which upon 100 c.c. A.S.T.M. distillation test yields fractions, or 10 per cent readings, ranging six, eight or 10° F. apart (which some refiners term a "close packed distillate" or "close cut" is a much better distillate for use as a blending medium than the distillate formerly produced with inefficient towers, with 10 per cent readings ranging 20, 25, and 30°F. apart. The reason for this is apparent, for the first mentioned distillate is a better dissolving medium than the latter, and greater quantities of a selected natural gasoline may be dissolved without so quickly affecting the initial boiling point, vapor pressure, and recovery of the finished blend. The close cut distillate accepts more of the lighter distillate than the other, or "wide boiling range" product, and at the same time the resultant blend will be more uniform and lacking in "gaps" upon distillation test and the plotting of its boiling range curve.

As to the lowering of temperature reading of maximum temperature or end point, evidenced upon the distillation of blends in laboratory testing, there is little need for explanation. The end point of the blended gasoline is invariably lower than the end point of the heaviest component and is directly proportional to the amount of the heaviest constituent employed. The reduction of end point is purely physical and is due only to the mechanics of vaporization in that a new and different force of cohesion, as was explained above, is exerting itself. Mechanically the molecules of the lighter compounds or components carry over a greater proportion of the heavier and higher boiling point molecules, thus reducing the final boiling point.

In their efforts to obtain as much marketable gasoline from the crude as possible refiners generally produce, in addition to their cut of light or export grade, and the heavier U. S. Motor fuel, a naphtha of low gravity and relatively low end point; 445 to 450°F. This heavier distillate can be worked off in small proportions in blends. The heavier naphtha, the U. S. Motor grade, and natural gasoline are usually the three essential components of blends. Occasionally where necessity requires it some small proportion of the "export" grade is employed in the preparation of two or three-way blends, or it is itself blended with naturals to gain gravity required by export buyers and volatility to buyers specifications. The three essential components mentioned, however, are generally sufficient for the preparation of blended products of finely uniform characteristics; and blends can be produced meeting practically any specifications as to gravity, initial boiling point,

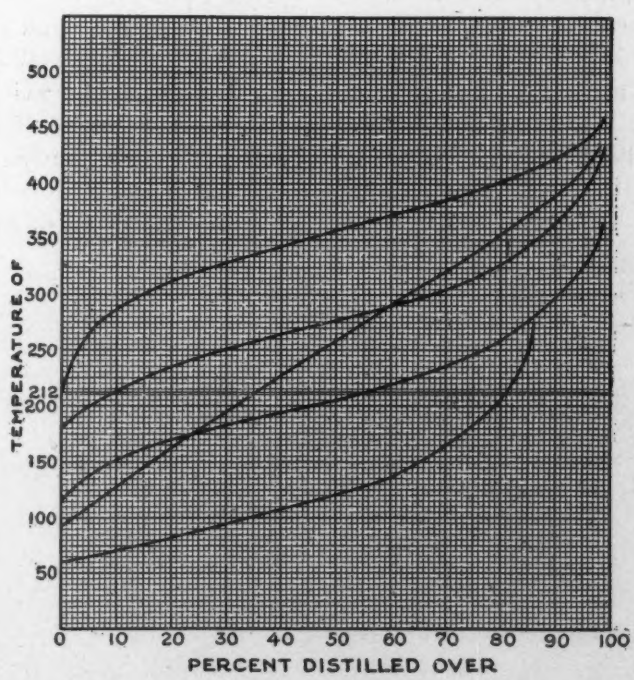


Diagram No. 1—Curves of four components used in blending to make uniform motor fuel as shown in the center "straight line curve."

end point, 10, 20, 50, and 90 per cent point, and 96 to to 98 per cent total recovery.

In the accompanying chart taken from the notes of the writer and prepared in 1923 before the installation of modern fractionating equipment, there is shown distillation curves of four products which were blended in such manner as to use the entire production of "export," "domestic," and naphtha grades from the refinery and the production of a company owned compression gasoline plant, each day, and at the same time produce a blended fuel of uniform characteristics having a "straight line curve," which is thought to indicate uniformity of product and a well balanced motor fuel in that there is a uniform volume or percentage distilled for each degree rise in temperature. The blend with this "straight line curve" is made up of 20 per cent of 89 gravity, 275 end point natural gasoline; 23 per cent of 65 gravity, 365 end point, "export grade"; 31 per cent of 54 gravity, 437 end point, "domestic" motor fuel; and 26 per cent of 48 gravity, 460 end point naphtha. The balancing of the two lighter grades against the two heavier grades or components is nicely shown in the resultant curve of the blended gasoline. The physical laws discussed in the foregoing are shown in their application in that initial boiling points, 10, 20, 50, and 90 per cent points, and end points of four components blended are changed when the new solution was prepared.

In regard to the straight line curve type of motor fuel which is becoming more predominant in marketed gasolines, this type of curve, or fuel, is easily secured through the use of stable naturals and one or more carefully selected and prepared petroleum distillates. A few laboratory mixes prepared in separatory funnels will indicate the proper proportions and specifications of blend components. Incidentally, a study of "Bureau of Mines, Semiannual Motor Gasoline Surveys" will indicate that this type of fuel is becoming more and more popular and extensively marketed. The current "Report of Investigations, R. I. 2995, March, 1930, Figure 2," presents in its distillation curve of average gasoline for January, 1930, a curve that is practically straight.

GRAVITY AND BLENDING

Gravity has been, as far as possible, omitted from this discussion, for the reason that gravity, as such, has no place in motor fuel specifications because it indicates nothing of value to marketer or purchaser of gasoline. Detail reports of gasolines sold throughout this country show wide variations in gravity, but indicate a much closer adherence to volatility characteristics. For the past several years there has been a steady decline in the 10 and 20 per cent boiling range of gasolines coincident with a "closer packing" of all other intermediate boiling points.

In actual plant operation, however, and as a means of checking processes and blending, gravity is essential. In blending for volatility and the10 per cent boiling point, even though the final gravity is of no importance as a specification of the finished blend, it is necessary to know the gravity of each component because of the ease with which the blending orders may be given operators.

The blending formula employed where refiners wish to continue blending to gravity, or for use where experiments have indicated that certain proportions of naturals and refinery distillates give best results, and which is a handy working device where the gravity of the blending bases and the naturals vary one or two degrees A. P. I. is simple and effective. Incidentally this formula is the one which was sold to refiners and natural gasoline manufacturers several years ago at the price of about $100 for the "secret." In preparing a 60 gravity blend from 88 gravity natural and 54 gravity refinery blending base, for example, the rule is as follows: Subtract the known low gravity from the known high gravity as — 88 minus 54 equals 34.

Subtract the known low gravity from the desired gravity as — 60 minus 54 equals 6.

Add ciphers to the result of the second subtraction and divide by the result of the first subtraction, as 600 divided by 34 equals 17.7—per cent of 88 gravity required to blend 54 gravity to 60 gravity.

To check accuracy of calculations multiply the percentages by the gravities as follows—88 times 17.7 per cent gives 15.576. Also, 54 times 82.3 per cent gives 44.442. Thus, 44.442 plus 15.576 gives 60.018.

Barnsdall Oil Company's Gasoline Plant, at Elwood, California

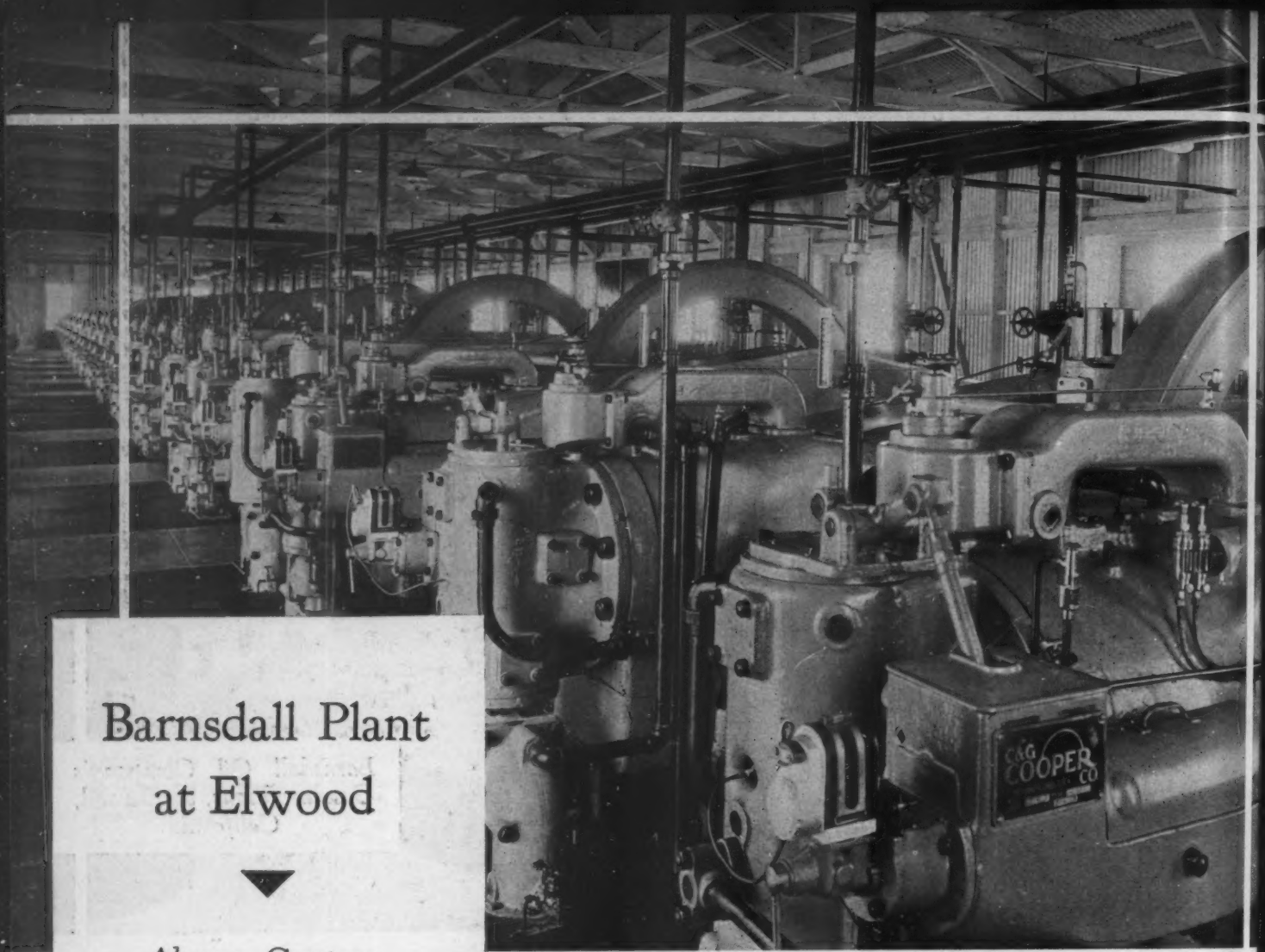
Plant Keeps Step With Growth Of Elwood Field

By BRAD MILLS

THE meteoric rise of the Elwood field from a doubtful wildcat structure to a potential production of 90,000 barrels in less than two years has been accompanied by additions to Barnsdall Oil Company's original natural gasoline plant which have placed it among the most efficient installations in California. Starting with one small unit, following completion of the discovery well in 1928, the plant has been enlarged until it is now handling about 42 million cubic feet of gas, with a gasoline recovery of around 56,000 gallons daily.

Conditions in the Elwood field are ideal in some respects for efficient plant operation, while in others problems are encountered which are not found in many Los Angeles basin districts. Such a natural advantage as a well pressure sufficient to send the gas through the traps to the absorbers without the aid of compressors is partially offset by the extreme hardness of water used in the various cooling operations. Regarded perhaps as nearest to an ideal oil field of any yet discovered in California, treating of the natural gas has become an important part of field operations and promises to reach even greater proportions.

The plant is located on the edge of a high mesa which ends abruptly to form a cliff dropping down to the Pacific Ocean. All gas was originally obtained from wells on the mainland, but the inauguration a year ago of drilling on tidelands has resulted in a practice which has led to the production of a large percentage of the gas from wells drilled on piers several hundred



Barnsdall Plant at Elwood

Above: Compressor Installation.

Below: Fat oil, lean oil, dephlegmator and water spray pumps are operated on a single shaft.

feet out in the ocean. This gives the plant the unique distinction of being the first to treat large quantities of natural gas produced outside the mean low tide line. Transportation facilities are ideal, the plant being located almost directly on navigable water, a trunk line railway and one of the best highways in the state.

Gas from the field comes to the plant through three main gathering lines at a pressure of 40 pounds. This ideal field or trap pressure eliminates the use of compressors, although it is not anticipated that this condition will be permanent. Before entering the five Barton, Manning and Warner absorbers the gas passes through scrubbers and the necessary headers for proportioning the incoming volume. After treating, the dry gas is sent to a scrubber tank and into the lines of the purchasing company.

COMPRESSOR EQUIPMENT

The dry gas leaves the plant proper at a pressure of 25 pounds, going to the compressors, which are used for boosting the pressure to the level required for sending it to market in the outlying cities and towns. The compressors are now supplying dry gas for the lines leading to Santa Barbara and Santa Maria at a pressure of 200 pounds.

The compressor installation includes 12, 190-horsepower, twin type Coopers, nine of which are used for boosting the dry gas leaving the plant to the desired pressure, with three being used to pull vapors from flow tanks scattered about the field. As the trap pressure declines, it will be necessary to install more compressors to boost the wet gas to the pressure required by the plant, if the present quantity of gas is treated. If a smaller volume is treated, it may be possible to switch some of the compressors now used for boosting dry gas to the battery required for ordinary plant operation. There is every indication, however, that more gas will be treated and additional compressors will be installed. The well pressure promises to be adequate for plant purposes for some time.

Lean oil from the pumps enters the top of the absorbers at 70°F.; passes downward and leaves for the Southwestern heat exchangers at 76°F. It then enters the stills at 322°F.; flowing downward with the vapors leaving the top. The oil leaves the stills at 328°F.; passes through the cooling tower and back to the pumps for another run of the circuit.

No. 1 kerosene is used for absorption oil, this practice having proved especially satisfactory in treating Elwood gas.

Vapors from the top of the still leave for the cooling coils at a temperature of 205°F.; entering the rundown tanks in the form of a liquid before going to surge tanks. Two motor driven pumps are used to move the gasoline from the surge tanks to the Southwestern rectifiers at a pressure of 150 pounds.

Three large Fluor cooling towers are used, two supplying the needs of the plant proper and one being used for the battery of compressors. All are equipped with Griscom-Russell self-scaling sections, this equipment proving especially adapted to the extremely hard water used.

The Fluor Corporation is now building an evaporating plant to distill ocean water for use throughout the plant. It will have a capacity of 1000 barrels per day, using Griscom-Russell equipment.

The pump installation is one of the most modern yet installed in California. Steam and electrically driven centrifugal pumps are used for all phases of circulation and have proven satisfactory for the maximum pressures maintained. Fat oil, lean oil, dephlegmator water and spray water pump units are located on a single shaft. Each shaft is driven either by a 75-horsepower electric motor or a steam turbine. There are six sets of these line shaft pumps, each containing one of the four types of pumps named in a previous sentence. Each fat oil and lean oil turbine pump has a capacity of 220 gallons per minute, the dephlegmator pump 100 gallons per minute and the spray water pump for the cooling towers 1000 gallons per minute. Two sets of pumps are used at a time, one electrically and one steam driven unit being adequate, with one of each type standing idle and a sixth being held for emergencies. Both the steam and electrically driven units operate at 2800 R.P.M. All centrifugal pumps are by De Laval, with General Electric motors.

Two small centrifugal, electrically driven pumps are used for pumping gasoline to the top of the rectifiers, each having a capacity of 50,000 gallons per day. On the same shafts are small centrifugal water pumps which are used for controlling the temperature in the rectifier, resulting in specification gasoline. Requirements are so exacting that this arrangement has proven especially useful and efficient. With one water pump and one gasoline pump on each of the two shafts, the same speed of each is maintained and cooling takes place in direct proportion to the quantity of gasoline handled.

The gasoline recovery is running from 90 to 91, depending upon the heat and pressure in the rectifiers. Gasoline goes from the rectifyers to storage tanks under its own pressure.

The boiler installation includes two 150-horsepower Titusville and five 70-horsepower Baker boilers, all of the standard water tube type.

Hard water is a problem which requires constant attention about the plant, that now used running about 92 grains of solids.

Before the second unit of the plant was completed, a full 100 per cent overload was carried for a short time, past performances indicating that should it become necessary, much more than the present amount of gas may be treated. Built to care for a variety of pressure changes, flexibility of the plant will insure efficiency under any ordinary circumstances.

Contact Filtration

By G. T. YOST
Resident Chemist, Pure Oil Company, Marcus Hook, Pa.

ALTHOUGH the fine clays were used to decolorize oils in the neutral as well as in the acid state as far back as 1868, the usual method employed for the improvement of color in petroleum oils was to percolate the oil through a column of coarse fuller's earth. This method is used extensively today with remarkable results. However, a great deal more attention is given to the contact filtration where more efficient results are obtained by the use of finely divided filtering materials of from 100 to 200 mesh fineness. With the same amount of clay more adsorptive surface is offered to the oil to be treated than with coarse clays which are used by the percolation method.

In the contact process, many different kinds of clays are used. The most noted are the Florida, Georgia, Texas, California, and Utah clays. Considerable variation in decolorizing efficiency is obtained with various clays on a given oil.

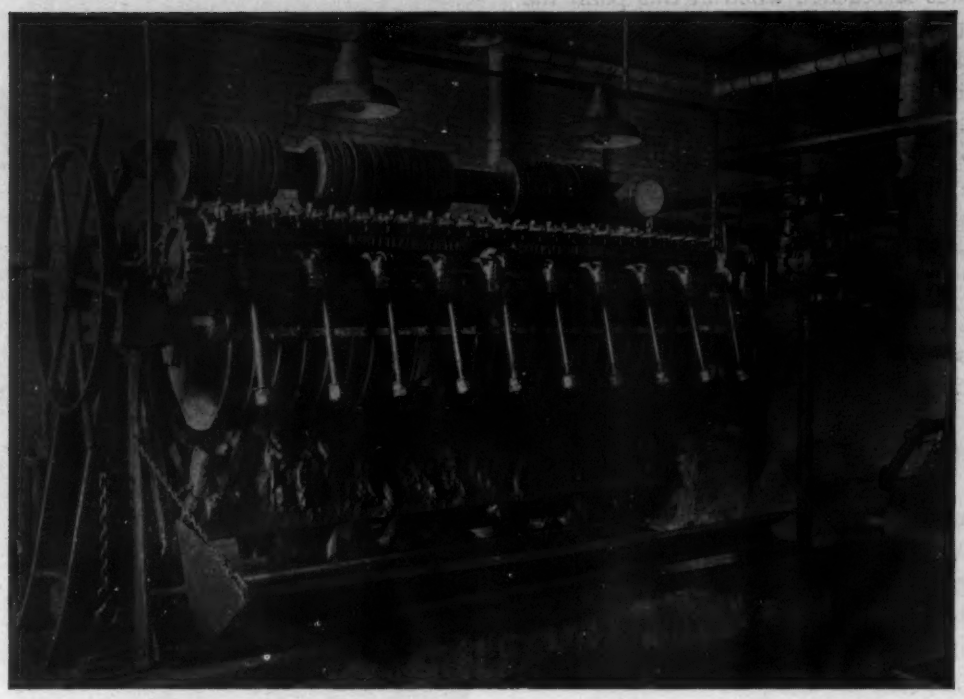
The various methods of filtration demand the proper kind of fine clays to give the most efficient results. In the pulp process, the fine clay contains considerable moisture. When oils are treated in this manner, the pulp is blended with the oil to be treated in the proper proportion and heated to nearly the flash point of the oil. At this temperature water flashes to steam, serving two purposes: to facilitate the polymerization of unsaturated hydrocarbons which renders such compounds more susceptible to filtration, and at the same time serves as a blanket over the hot oil, preventing oxidation. It is not necessary, however, to treat oils at high temperatures to obtain good results, although it is generally conceded that as the temperature increases, the color efficiency increases.

An acid treated oil which has been properly treated can likewise be contacted with fine clays at lower temperatures. In this case, however, when temperatures do not exceed the boiling point of water, special care should be given to the free moisture content of the clay as an excess of moisture either from clay or from other sources will not only give poor results as far as decolorizing is concerned, but will also render the filter cake more difficult to extract the retained oil, thereby causing a greater loss.

ADSORPTION

The decolorizing property of fuller's earth or any finely divided porous substance is due to physical-chemical process called adsorption. This action is on all chemical compounds and may be measured by the heat of reaction as it was found that the greatest heat was developed on compounds which are the most active from a chemical standpoint. The unsaturated hydrocarbons cause the greatest reaction, while the naphthenes are less reacted upon followed by the paraffins hydrocarbons. Other reactions have been noted: that naphthenic acids are feebly reacted upon; that iodine value is considerably lowered and to some extent the sulphur content. It is also noted that resinous and tarry substances are also very readily adsorbed. Such substances which are more readily extracted by the use of other cheap chemicals such as sulphuric acid are generally taken out before subjected to the clay treatment.

The fact that one clay has a greater capacity for adsorption than other clays is not due to its chemical analysis, but is due to its structure. Some clays have the natural capacity for adsorption while others require a chemical treatment which tends to make them more porous and at the same time increases the adsorption surface. It is without doubt that even the smallest particles of clays are traversed with countless microscopic canals. These canals increase the adsorbing surface enormously. The fact that not all finely divided substances have this adsorptive power is well illustrated with sand which is practically devoid of decolorizing power compared with a much coarser clay. This can only be explained by the fact that filtration does not



Filter Press

only take place with finely divided particles, but with those that are porous and traversed with these minute canals. When these canals are blocked with carbon or similar substances, the clay is devoid of decolorizing power and is then known as spent clay.

In the process of contact filtration, neutral as well as acid treated oils can be successfully treated with fine clays. In the case of acid treated oils, special care should be taken that the oils are properly treated to obtain an acid oil free from sludge and at the same time having a low acid number. Oils contacted in this manner produce a filtered oil which will pass the required emulsion test. If, however, the treated oils contain finely suspended pepper and contain a high percentage of acid, an excess amount of clay must be used, and the finished oil will not be as resistant to the emulsion tests. Some refiners strain through a bed of coarse clay to agglomerate particles of acid sludge, while still others centrifuge acid treated oils before contacting with fine clays. It is not necessary, however, to resort to such treatment unless it is for lack of sufficient settling capacity, if oils are treated in the proper manner and at the proper temperature. It can not be said, however, that the acid losses and the settling of acid sludge does not have some bearing on the manner in which oils have been handled in the preliminary processes; the success of the acid treatment and contact filtrating does not only depend upon these processes, but also depends upon an accurate temperature control and the methods used during distillation.

Contact Tanks

MECHANICAL CONTACTING

After having settled acid oils for a period long enough to be assured that all sludge has been settled the time averaging between 30 to 40 hours, depending upon the temperature, viscosity, and on the degree of acid treatment, the acid treated oils are pumped into mixing or contact tanks provided with cone bottoms. The required amount of fine clay, which has been determined by laboratory experiments, is then blown in by air and the mixture thoroughly agitated by air or some mechanical means such as centrifugal pumps which take suction at the bottom of these tanks and discharges continually into the top. The temperature of contacting is very important as it depends upon the type of clay used, the time required to raise the oil to the desired temperature, and the kind of oil to be treated. When the oil and clay have been contacted for a sufficient period of time to obtain the maximum decolorizing efficiency for the amount of clay used, the mixture is then charged to filter presses which are provided with plates covered with very fine metallic filter cloth. The filtered oils pass through the fine meshes leaving the clay as a cake on the plates. As the cake gradually builds up, the pressure also will increase until the

maximum 50 pounds is reached when at this point the charge is turned to another filter press. The retained oil is then extracted by air pressure or in some cases by naphtha washing until the cake is practically free from oil. The press is opened and the spent clay dumped into a pit which is carried by a screw conveyor to the outside of the building where it can be hauled away as spent clay or revivified by burning in a specially constructed kiln.

At the Marcus Hook refinery of the Pure Oil Company, the contact filter plant consists of a two story brick building. On the first floor, the three cone shaped contact tanks each having a capacity for 110 barrels occupy one side of this floor, while the centrifugal pumps which are used to charge the contact tanks from the agitators are on the other side. These pumps are used for two purposes: to charge tanks and filter presses, and also to insure intimate contact between the fine clay and the oil. A centrifugal pump in itself affords considerable agitation by virtue of its construction, but when the maximum agitation is desired the discharge of the pump is directed into another centrifugal pump which rotates against the direction of the oil and clay. These pumps are connected on the same shaft operated by one motor. The speed of the motor can be so regulated by a rheostat that almost any pressure can be maintained while circulating to obtain the desired contact.

The second floor of this building consists of the upper half of the three contact tanks, the two Sweetland filter presses and the recording instruments. This plant has sufficient capacity to filter 450 barrels during a day shift. However, this amount could be considerably increased by lengthening the filtering time.

The advantages of using fine clays for decolorizing oils is tending to make the contact process stand out each year more prominently than the percolation system:

1. This process produces a uniform color throughout the batch. The degree of decolorizing is the same at the beginning as it is at the end of the batch.

2. The investment of a contact plant is considerably less as it is possible to install a plant on a much smaller area at half the expense of building a percolation plant.

3. The labor and power per barrel throughput is considerably less than in the percolating system.

4. It is also a fact that by mixing the oil with a decolorizing agent, the process is carried out in a much shorter period of time than by the percolation process.

Filter House

5. Fine clay is easier handled at filter plants in comparison to coarse clay as air pressure and pipe lines only are needed.

It therefore appears that the contact process has many advantages in its favor over the percolation process. With the difficulties of mechanical equipment practically solved, the contact process has yet one more step to overcome, *i.e.*, to successfully revivify finely spent clay on a commercial scale. This is being worked on experimentally with a great deal of success. When these developments are worked out, the clay expense which has been considerably higher on this process will compare favorably in all phases with the percolation process.

Compactness and Efficiency at Vacuum Oil Company Plants

THE refineries of Vacuum Oil Company, located at Olean, New York, and Paulsboro, New Jersey, contain several modern distillation units, built on the same basic principles, but operated under different conditions.

The most important of these units are of a two-stage type, second stage being operated under a high vacuum. These units are used for the fractionation of Pennsylvania crude from the fields adjacent to the refinery at Olean; also for Ranger and Burbank crude handled through the company's tank storage terminal at Texas City, Texas, and for Coastal crude produced at the company's Lake Charles, Louisiana, field which is loaded through its terminal facilities located within six miles of the wells.

There are also two units of a single-stage type which fractionate pressed wax distillate, and another unit which handles cylinder oils in solution. These distillation units operate continuously, the charge being preheated in heat exchangers by the products of distillation and fractionation on its way to the tube still. The heated charge is delivered to a bubble type fractionating column where the fractions are removed in continuous streams. In the first stage of the two-stage continuous units, the light products are removed and residual oil from the atmospheric tower passes through the second still for further heating and the heavier fractions are separated in a vacuum tower. It is of interest to note that the installation handling Pennsylvania crude was the first installation of its kind to be erected and operated in the refining industry.

In the unit handling Coastal crude the charge is preheated in a series of exchangers before being delivered to the first stage tube still. In the still the charge is heated sufficiently to effect the distillation of kerosene, which is taken overhead, and gas oil and light lubricating oil, which are withdrawn from the side of the column. The residuum from this operation is delivered to the second stage still where it is heated sufficiently to vaporize four lubricating oil cuts and to produce tar bottoms. This second stage is operated under vacuum, and in this installation the vacuum tower is much larger than the atmosperic tower for the reason that the quantity of light fractions contained in the Coastal crude is relatively small.

The unit operating on Ranger-Burbank crude is also a two-stage atmospheric-vacuum type installation. The charged oil is preheated in heat exchangers and then taken to the still. In vaporizing 50 per cent of the charge five fractions are removed through the atmospheric tower in addition to the residuum which is passed on to the vacuum or second stage of the unit. Light gasoline is removed from the atmospheric column as overhead vapors, extraction naphtha, heavy naphtha, kerosene, and gas oil are removed as liquid side streams.

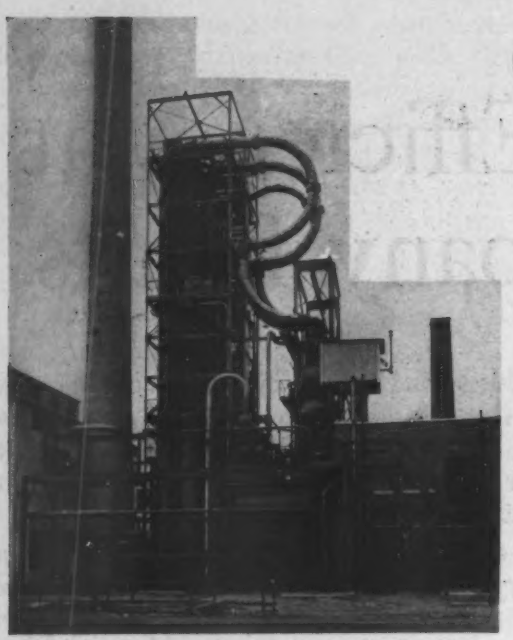
The residuum from the first stage operation is further heated in the vacuum unit to effect the vaporization of all but approximately three per cent of the original charge. Heavy gas oil is recovered as overhead vapor from the vacuum tower, and pressable wax distillate, heavy wax distillate, and overhead cylinder stock are removed as side streams, leaving flux bottoms.

The rerun unit is charged with pressed wax distillate, the charge being heated in exchangers and heating continued to desired temperature in the tube still, and from there into the fractionating column. Vapors removed from the top of the tower are light gas oil. Two different viscosity lubricating oils are removed as liquid side streams and a lubricating stock of higher viscosity remains as bottoms. Exhaust steam from the pumps is superheated in the tube still for process work in the stripping sections within the tower.

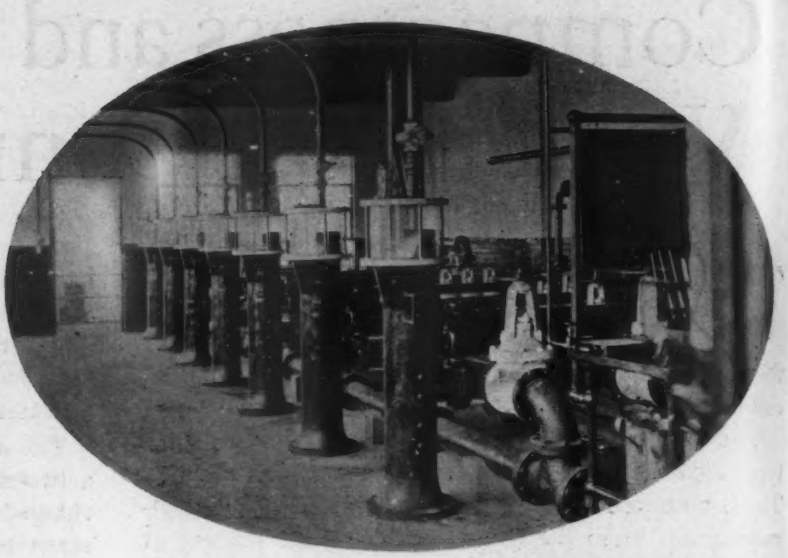
These units are striking examples of the modern refinery installation where high efficiency is secured and excellent economy of processing, in units exceedingly compact in design and construction. The following two pages are devoted to photographs of the installations discussed above in operation at the company's refineries at Olean, New York, and Paulsboro, New Jersey.

On succeeding pages are shown views of interiors of Vacuum Oil Company's plants at Olean and Paulsboro

Compactness and Efficiency in



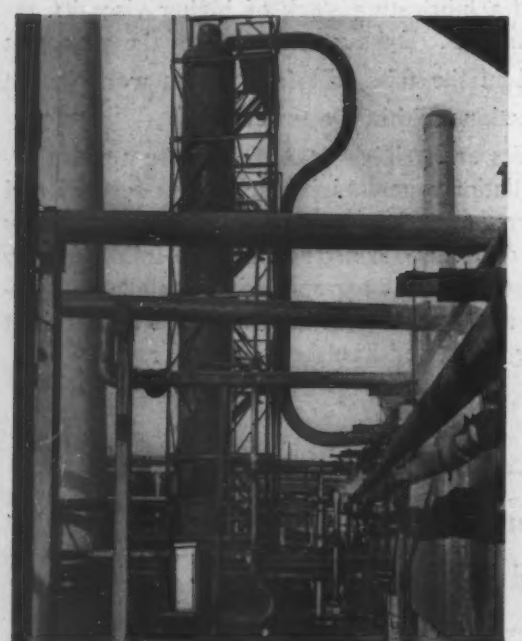
Two stage vacuum-atmospheric unit at Olean, New York



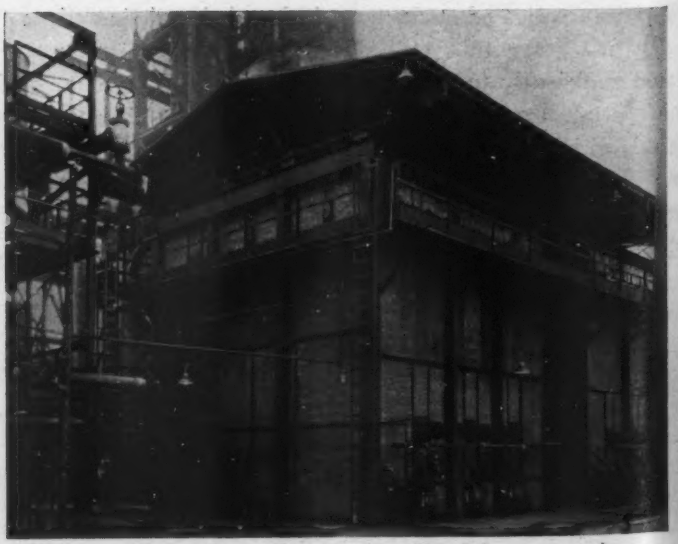
Receiving house interior at Olean

Wax Distillate Rerun unit at Paulsboro, New Jersey

Wax Distillate unit at Paulsboro

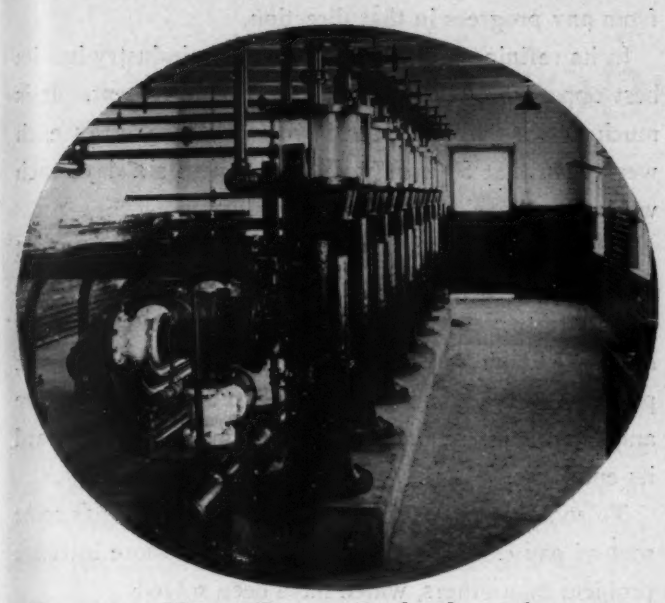


Wax Distillate rerun unit, Paulsboro



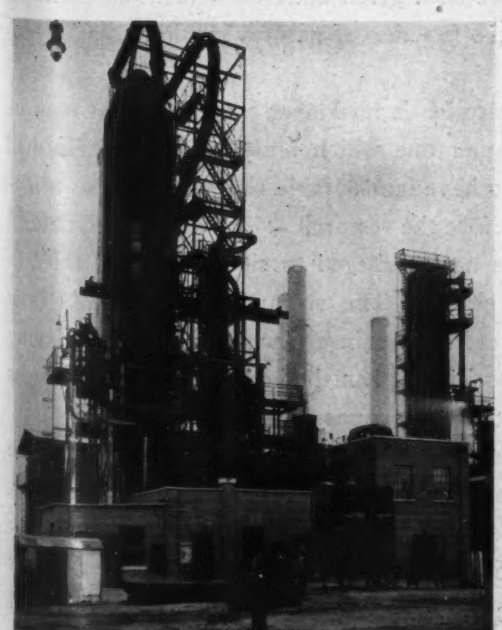
Coastal crude unit at Paulsboro

Vacuum Oil Company Plants



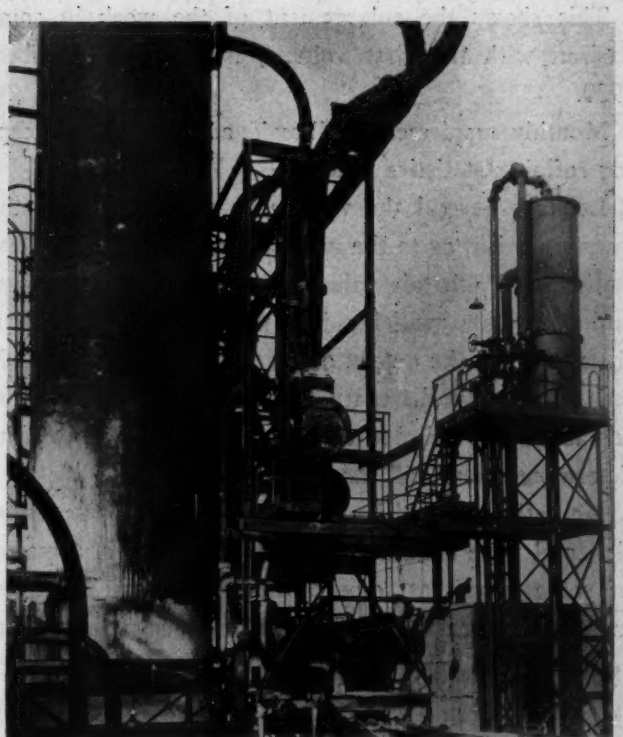
Receiving House Ranger-Burbank crude unit at Paulsboro

Control Room coastal crude unit at Paulsboro plant



Coastal crude unit at Paulsboro

Ranger-Burbank crude unit at Paulsboro



Ranger-Burbank crude unit, Paulsboro

REFINER
AND NATURAL GASOLINE
MANUFACTURER

EDITORIALS

A FIRST perusal of "Summary of Statistics of Importance to Refiners," compiled by the Western Petroleum Refiners Association, prompts a word of commendation for the style in which the material is presented. Both H. K. Davis, economist, and E. H. Ritter, statistician of the organization, deserve praise on this score. The wealth of information as presented bears evidence of painstaking research, careful preparation and design for use.

The following from a letter which accompanied the volume gives an idea of the scope:

"We now show supply and demand for all petroleum, and crude to refiners' stills, in greater detail. We now include information regarding gasoline taxed or inspected under state laws; seasonal variations in gasoline production and shipments for various refining groups; ratio of gasoline production to shipments; natural gasoline production, shipments from plants, and stocks; and gasoline production at refineries by method of manufacture."

This shows the enlargement of the work in comparison with the first volume, issued in September, 1930.

Monthly supplements will make an easy task of keeping refining statistics timely.

Looking beyond the volume as a finished job, the question arises as to the use that will be made of these statistics. With this volume, the monthly supplements and other data available, it is possible now for executives to guide the output of plants with accuracy. Only lack of use or a disregard of accurate guiding material can leave any refining unit at a loss for a compass to determine sound still throughput.

No refiner should be without a copy of these statistics, and none should fail to use them. It is a matter of some hope that some of the changes and enlargements in material are the result of suggestions from refiners.

WHILE attention is being given to the matter of balancing refinery output in keeping with seasonal and sectional requirements, there is an opportunity to deal with the matter of balancing employment.

Industry in general is coming to realize the advantage of workmen having steady employment. This is primarily a humanitarian venture. But industry will profit from any progress in that direction.

In its refining division, the petroleum industry has its best opportunity to contribute to this movement. It is much better that 100 men have work three days each week than that 50 men have employment six days each week.

Unfortunately the assurance of steady employment can not be determined as easily as the dividing of a week into two equal parts. But the petroleum industry has a creditable record of its dealings with labor. Stock purchase plans, insurance, housing and medical care are ample evidence of the attitude of this industry toward its employes.

To so arrange working hours that each man has some sort of pay check each half month, is no more intricate problem than others, which have been solved.

IT is doubtful if those responsible for the research program in regard to natural gasoline had any conception of the contribution this effort would make to the whole subject of motor fuel. The Natural Gasoline Association of America sponsored its research work primarily as an effort to determine the place of natural gasoline as a part of finished motor fuel.

But the work of Dr. George Granger Brown of the University of Michigan, who has conducted the experiments and presented the findings, ranks today as the outstanding contribution on motor fuel manufacture and performance. The experiments have given natural gasoline its rightful place as a part of the gasoline of the world. But beyond that, students of gasolines and their use have been given material which has extended far beyond the function of natural gasoline as a "blending agent."

Natural gasoline is no longer a product that may be used, but rather one which must be used, if finished gasoline is to have its desirable characteristics as a motor fuel. Before the research effort was begun, natural gasoline was not privileged to sit at the head table in motor fuel circles. The research program was little short of an effort to gain a place in this circle. Having gained the position, it has climbed to the point where its voice is first in these counsels.

The admirable part of this is that the natural gasoline industry is accepting its position in such fitting manner. It is still the student of motor fuel. Justified to speak as the authority, it is heard as the investigator only. Its findings are offered not as the last word on a subject but as another step in reaching an ever elusive goal.

Texas and East Coast Refinery Operations Excessive

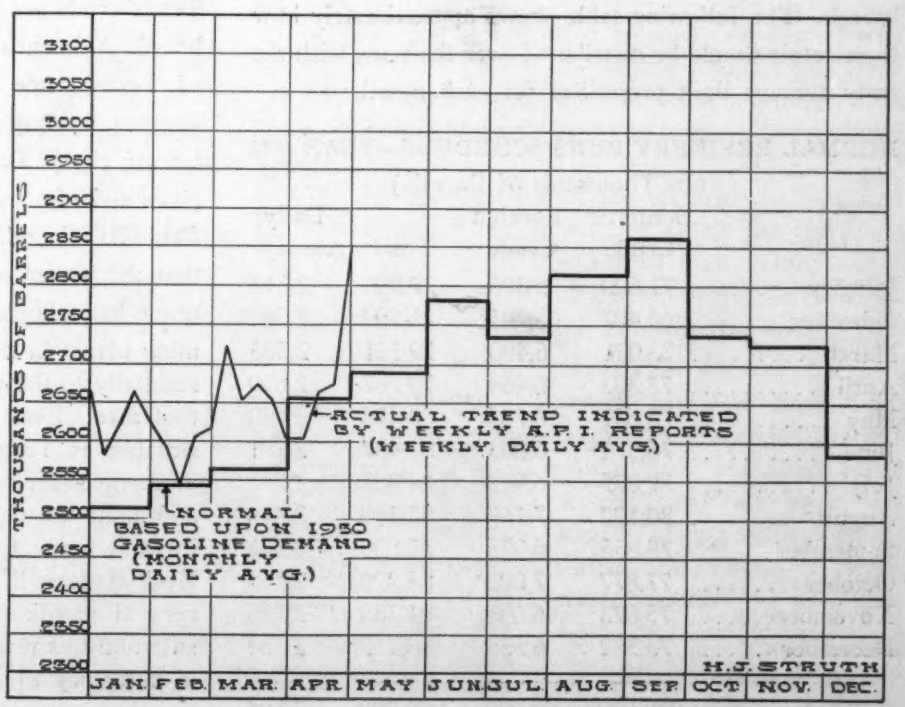
By H. J. STRUTH
Staff Economist

SPORADIC attempts to follow out the Federal Oil Conservation Board's constructive suggestion to curtail refinery crude runs have reflected little, if any, improvement in the stock situation. While it is true that stocks of gasoline have been drawn upon to some extent during recent weeks, it is apparent that this result has not been due to the application of corrective measures to reduce still runs. In fact, the extent of stock withdrawals can be said to have been more or less a natural sequence, whereas the rate of crude processing has attained a decidedly excessive level that has more than offset the effect of increased demand for gasoline. So marked has been the upturn in daily average crude still runs during recent weeks that the rate of gasoline manufacture is already about three months ahead of normal requirements. This condition prompts serious consideration of the refining industry and makes determined effort to correct the situation decidedly necessary to insure profitable results throughout the approaching season of peak gasoline demand.

Analysis of refinery crude runs by major refining districts of the United States reveals that Texas and East Coast plants are chiefly responsible for the over-manufacture of gasoline. According to the Bureau of Mines report for March, total runs to stills aggregated 80,062,000 barrels, whereas the normal limit prescribed by the demand for gasoline was 79,521,000 barrels. On a cumulative basis, total runs to stills since January 1, proved to be 232,639,000 barrels, compared with the normal prescribed limit of 228,619,000 barrels, revealing a cumulative excess of 4,020,000 barrels. During this period, Texas refineries consumed a total of 54,616,000 barrels, against an indicated normal of 49,200,000 barrels, or an excess of 5,416,000 barrels since January 1. To a lesser degree, East Coast refineries also recorded excessive runs amounting to 907,000 barrels. The latter is based upon actual runs of 41,318,000 barrels, against a normal limit of 40,411,000 barrels. Other refining districts of the United States during the first three months of this year exhibited a fairly well-balanced situation, apparently keeping run schedules within the limits prescribed by the demand for gasoline. In this connection, it is particularly gratifying to note that California refinery operations have been maintained at a rate somewhat below the prescribed limit.

CHART SHOWS COMPARISON

The accompanying chart presents a fairly reliable index of the status of current refinery operations by comparing the trend of crude still runs with the normal seasonal limits prescribed by the demand for gasoline. In this instance, the trend of actual runs has been based upon the weekly reports of the American Petroleum Institute, representing a corrected figure designed to



Status of refinery crude runs situation

cover the approximate total daily crude consumption of all refineries in the United States. It will be noted that actual runs have been consistently above normal since the first of the year, with the upward trend becoming more pronounced during April. In arriving at the normal monthly rate of crude runs necessary to produce this year's gasoline requirements, the rate of seasonal increase in runs to stills for former years was used as an influencing factor, rather than assuming that the refineries should only produce the quantity of gasoline required each month. In this way, provision is made for the accumulation of a normal over-supply of gasoline, to be used as a necessary reserve against increasing demand throughout the early seasonal cycle.

An ideal refining situation, however, would contemplate the processing of the same daily rate throughout the year, eliminating the necessity of increasing or decreasing runs to stills in conformity with seasonal product requirements. Accordingly, the daily rate of charge necessary for all refineries in the United States during the present year would be maintained at 2,685,000 barrels. During the week ending April 26, the daily average rate indicated by the A. P. I. reports was above 2,800,000 barrels, an excess of 115,000 barrels daily. A detailed study of the potential gasoline demand for this year, interpreted in terms of monthly crude still runs required has resulted in the conclusion that the industry should set its still run quota for 1930 at a maximum of 980,000,000 barrels. Of this total, about 80,000,000 barrels will constitute foreign crude, leaving a net demand for American crude of about 900,000,000 barrels. The following table shows approximately how these totals should be distributed over the year, with the daily average limit prescribed for each month:

NORMAL REFINERY RUNS SCHEDULE—YEAR 1930

(In Thousands of Barrels)

	Domestic Crude	Foreign Crude	Total	Daily Average
January	71,600	6,306	77,906	2,513
February	65,407	5,785	71,192	2,542
March	73,031	6,490	79,521	2,565
April	73,303	6,464	79,767	2,659
May	76,631	6,785	83,416	2,690
June	76,574	6,863	83,437	2,781
July	77,875	6,932	84,807	2,735
August	80,192	7,168	87,360	2,818
September	78,855	6,975	85,830	2,861
October	77,877	7,002	84,879	2,738
November	75,073	6,695	81,768	2,725
December	73,582	6,535	80,117	2,584
Total	900,000	80,000	980,000	2,685

American Petroleum Institute figures of refinery runs and gasoline stocks for the week ending April 26 show that runs of 95.6 per cent of the total potential capacity reporting aggregated 18,897,300 barrels, or a daily average of 2,699,600 barrels. Stocks of gasoline were reported at 53,212,000 barrels, representing a decline from the preceding week of 265,000 barrels. Since it is apparent that runs for the first three months of this year were excessive to the extent of about 4,020,000 barrels, the indicated over-manufacture of gasoline amounts to about 1,608,000 barrels. This conclusion readily reveals what could have been accomplished by the industry had attention been given to the Federal Oil Conservation Board's plea for curtailment of still runs. If runs had been maintained at the rate prescribed by the accompanying chart and table, stocks of gasoline would now be down to about 51,000,000 barrels, or a net gain since January 1 of only 8,000,000 barrels, instead of an actual gain of more than 10,000,000 barrels. It was to be expected that there would be a gain in gasoline stocks during the first four months of this year, but the rate indicated thus far is decidedly out of bounds.

CHEAP CRUDE RESPONSIBLE

Cheap crude has undoubtedly contributed to the conditions outlined above. Summed up, it is apparent that the state of Texas is mainly responsible, directly, through the continued over-production of crude and, indirectly, through an inflated demand for the low-priced oil that has resulted from over-production. Not only is crude produced in Texas being excessively consumed by refineries in that state, but large quantities of Texas crude are moving coastwise to the Atlantic seaboard. A recent survey shows that about 335,000 barrels of Texas crude is moving from Gulf Coast ports to Eastern refining centers. It is perhaps this extensive use of cheap Texas crude on the Atlantic Coast that prompted the recent reduction in posted prices of Pennsylvania oil. At the same time, it is well known that the advent of substantially lower prices for Texas crude has stimulated the operations of numerous skimming plants in the West Texas area, contributing substantially to the inflated demand for crude produced in that area. Even a most cursory study of the refining situation in Texas shows that crude is being consumed at an excessive rate by refineries located in West Texas and along the Gulf Coast. Unless some action is taken in these areas to curb refinery operations to a normal level, there will be little hope for improvement in the general gasoline or crude market this summer. The situation has reached the stage where immediate action is necessary to prevent a weakening gasoline market; one that may prove even worse than the slump that accompanied the peak demand last summer.

Cutting Losses by Efficient Vapor Recovery

By H. R. LINHOFF
Manager Gas Department, Richfield Oil Company of California

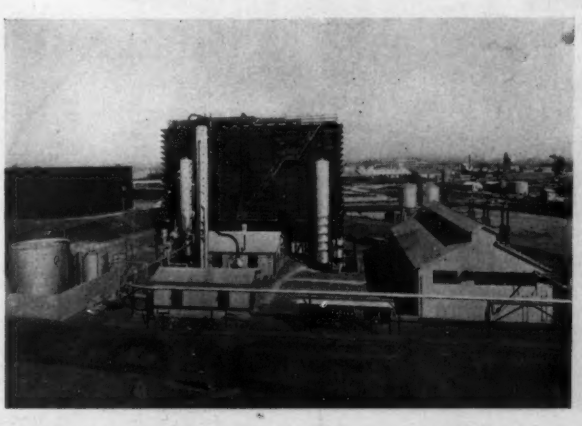
RICHFIELD Oil Company of California has just completed and placed in operation at its Watson refinery, Watson, California, a modern vapor recovery and fire prevention system that contains a number of unusual features. The plant is designed to handle a maximum of 5,000,000 cubic feet of vapors per day at 40 pounds per square inch gauge pressure, giving a leeway which is in excess of present needs of the refinery.

The science of vapor recovery and fire prevention at refineries is one of the most interesting and profitable phases of the petroleum industry. The Watson plant cost approximately $200,000 to construct, which, on a basis of 30 days practical operation, will be amortized within three months and will show a progt of about $750,000 annually.

The term "vapor recovery" as used in the petroleum industry, applies to the recovery and utilization of production, refinery and tank farm vapors, which if not recovered would otherwise be wasted. In the past the loss of these vapors has often been referred to as "evaporation loss" and producers and refiners have been inclined to neglect the importance of these losses.

It is now a well known fact that pumping of oil and changes in temperature in a tank farm actually cause vaporization of certain valuable fractions of the oil, practically all of which can be profitably recovered and the remainder used for fuel. Losses of this nature can be reduced in most cases by insulation, water seals and floating roofs, but they cannot be completely eliminated without some system of collecting and recovery for the vapors.

In general, a vapor recovery and fire prevention system such as found in a modern refinery and its tank farm serve several purposes. First, it utilizes receiving house and tank farm vapors, extracting therefrom a product similar in quality to natural gasoline and leaving residue or dry gas available for fuel. Second, it eliminates a serious fire hazard through collection and proper disposition of inflammable waste vapors. Another important function of such a system is the reduction in air content of the vapors in the tanks.



Showing Arrangement of Equipment

In addition to the usual tank vent valves such a system includes explosion relief valves, flame arresters, tank regulators, vapor collection and repressuring pipe line systems, a compression plant, an absorption plant and a stabilizer plant.

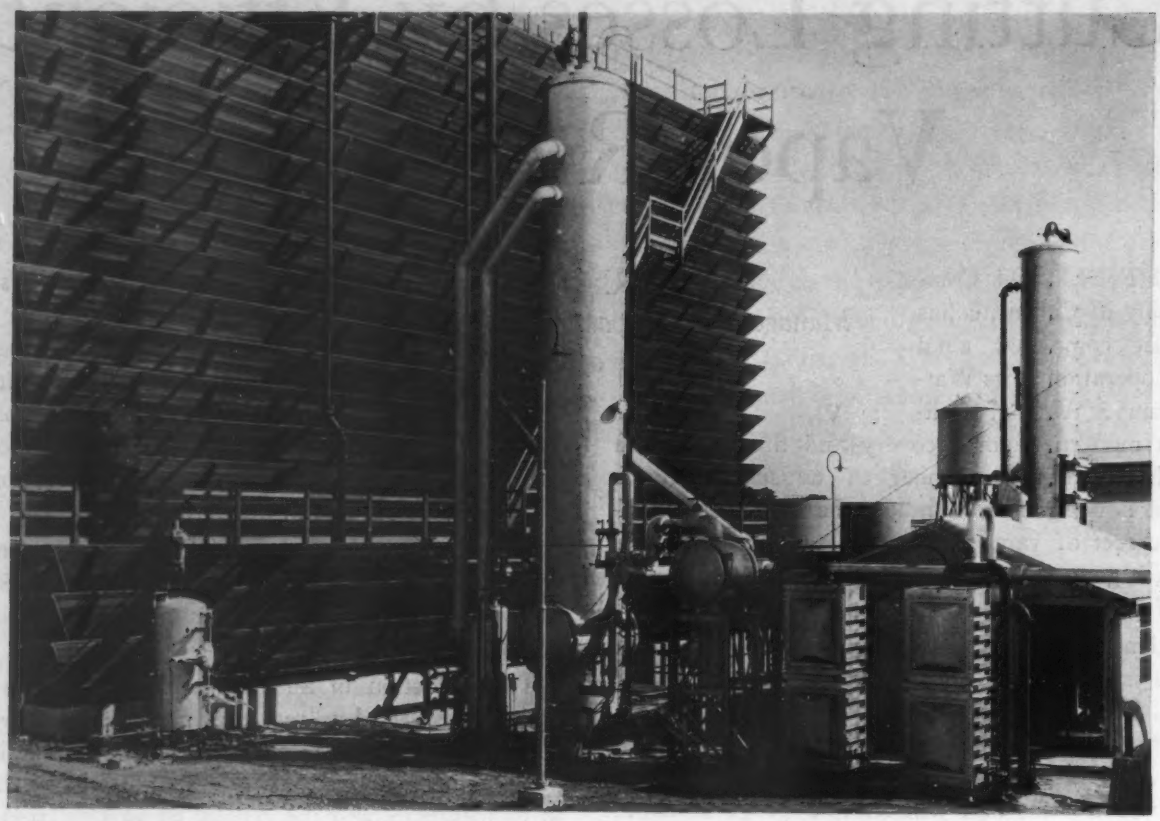
Partial removal of the gasoline fractions from the wasted vapors is obtained by compression and cooling and the remainder by absorption in oil, redistillation and condensation.

The reduction in air content of the vapors in the tanks is secured by "repressuring" the tanks with air-free dry gas as it is required. When a tank is being pumped out or when the contents of a tank are dropping in temperature, and the release of vapors from the oil is not sufficient to fill the vapor space caused by the rate of pumping or drop in temperature, instead of taking in air to fill the vapor space, air-free dry gas is admitted. The object in reducing the air content of the vapors in tanks is primarily to reduce the fire hazard and if tanks are properly equipped, and operated, the air content in their vapor spaces will rarely be sufficient to support combustion or to produce an explosion mixture. Another object in reducing the air content of the vapors in the tanks is to reduce oxidation and cut down the rate of corrosion.

The principal objects of a complete vapor recovery system are the recovery of gasoline and dry gas from otherwise wasted vapors, and the reduction in fire hazard to the entire refinery by proper disposition of these vapors.

With the development of the oil fields in Southern California during the past three years, the increased stocks of high gravity crude oil and the increased throughput of refineries, several new vapor recovery and fire prevention systems have been erected in this area. Companies already operating vapor recovery systems have enlarged existing systems or installed new systems to handle waste vapors from new tank farms and distillation units.

Richfield Oil Company's new system at Watson is composed of tank regulators, a

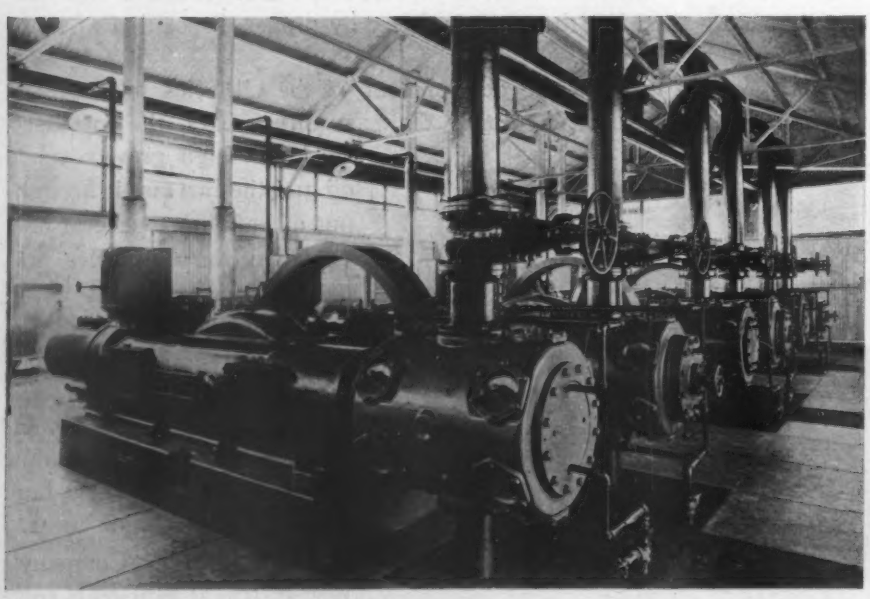


Distillation equipment, with water separators and gasoline accumulator on the left

vapor collection and repressuring circuit, a three-unit compression plant, an absorption tower, a distillation system, a high pressure stabilizer and a special cooling tower, built under the supervision of H. R. Linhoff, manager of the gas department.

SOURCE OF VAPORS

Vapor is supplied to the system from the look boxes of five crude oil distillation units and 75 active tanks, containing high gravity crudes, high gravity refined oils, motor fuel and natural gasoline. The average vapor collected and passed through the recovery plant contains from 10 to 12 gallons of gasoline per thousand cubic feet.



Compressor Plant

REGULATORS

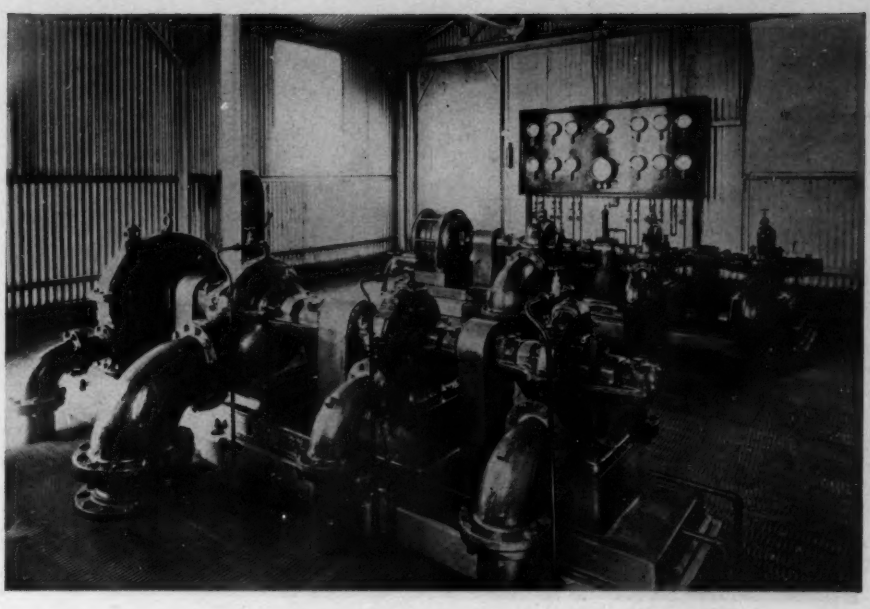
Collection of the gas is effected by the application of vacuum through tank regulators supplied by the Winkenson Controller Company. These regulators serve a dual purpose and consist of a pressure regulator and vacuum regulator controlled by a pilot valve operated by a single diaphragm. When the pressure in the tank builds up to a predetermined point, the pressure regulator allows vapors to pass from the tank into the collection line. The vacuum regulator is connected to an air-free dry gas line and opens when the vacuum in the tank drops to some predetermined point and allows dry gas to fill the vapor space in the tank.

The pressure and vacuum regulators are of the motor valve type actuated by the dry gas pressure used for repressuring the tanks. This feature insures a sensitivity

well under one-tenth of one inch of water vacuum or pressure.

A similiar controller without the vacuum regulation feature is used to collect waste vapors from the distillation units. Collection lines from the water separators and look boxes are run into a header leading to the regulator located near each receiving house. This regulator is actuated by the pressure in the header instead of by dry gas pressure as in the case of the tank regulators.

In addition to the tank regulators and pressure regulators the tanks are also equipped with vent valves, explosion relief valves and flame arresters supplied by Vapor Recovery System Company.



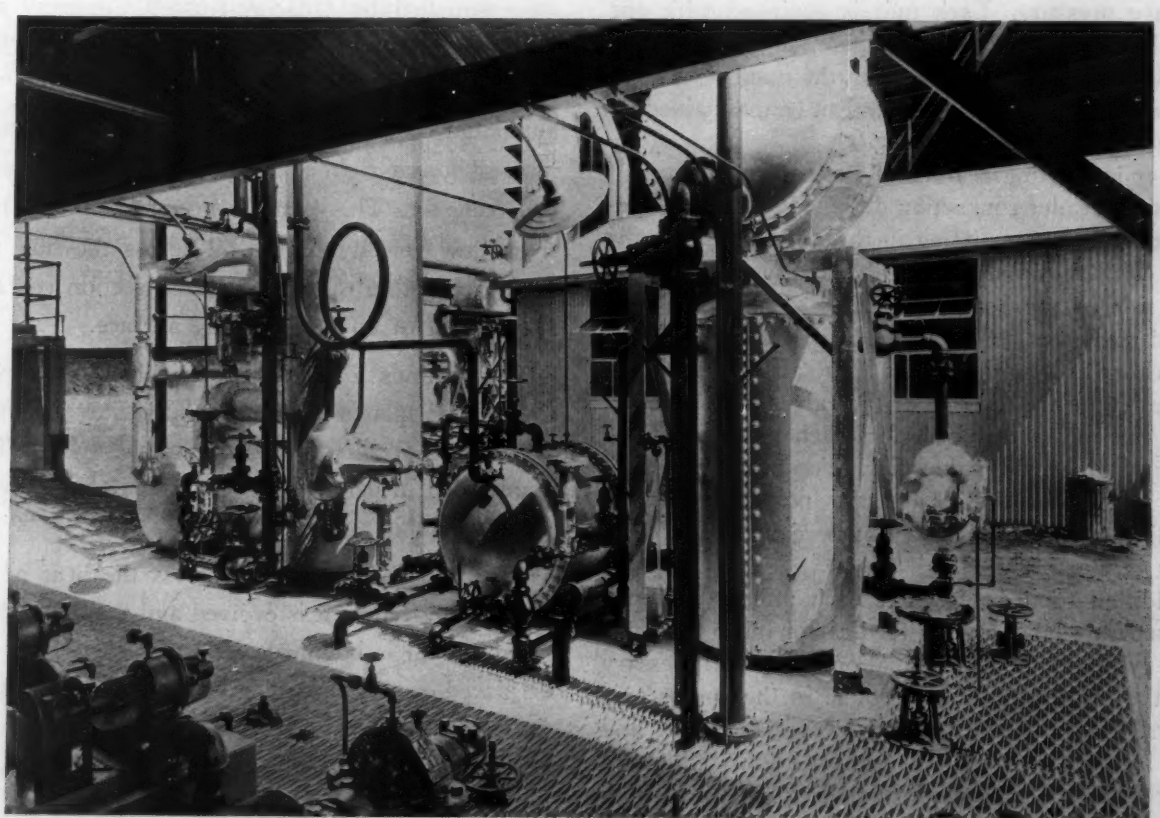
Triple pump units for water, lean oil and fat oil

COLLECTION AND REPRESSURING LINES

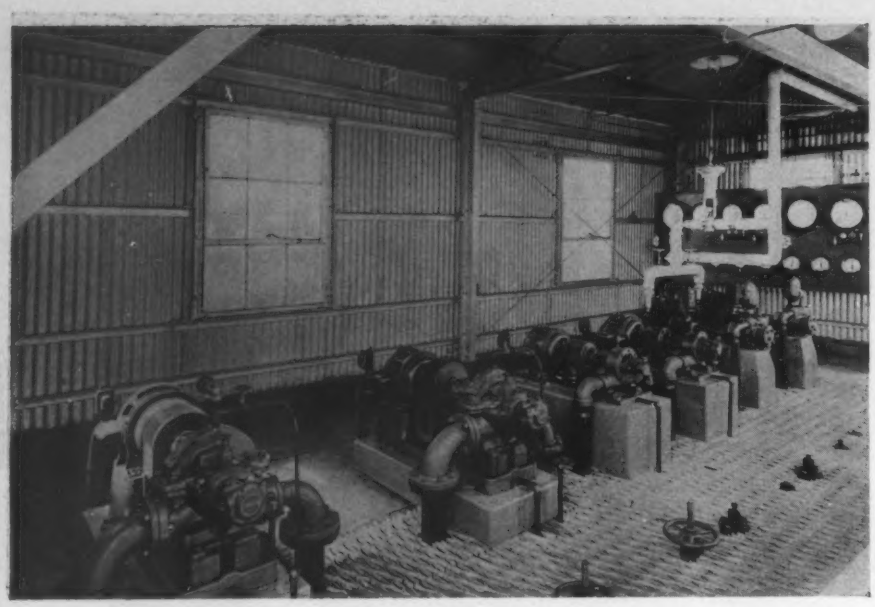
Passing from the tanks and receiving houses the waste vapors are taken through suitable lines laid so as to drain to a central point. Where the topography prevents complete drainage, means have been provided for removing and disposing of the condensate as it accumulates.

Removal of the condensate is automatically effected by a vacuum unloader supplied by Trumble Gas Trap Company. An interesting feature of this unloader is its ability to handle water, gasoline and emulsions at the same time with perfect satisfaction.

In order to protect the compression plant against failure of this equipment a special horizontal line scrubber is installed in the main collection line near the



Arrangement of kettle column, heat exchanger, reflux condenser and reflux accumulator with motor valves and liquid regulators



Water, reflux and feed pumps for stabilizer

plant. This scrubber is also equipped with a vacuum unloader of the same design.

COMPRESSION PLANT

The compression plant used for collecting and discharging the waste vapors to the absorption tower consists of three 180 brake horsepower, type XG, direct connected, Ingersoll-Rand gas engine compressors. These machines are designed for compression of vapors from 10 inches mercury of vacuum to 40 pounds per square inch gauge pressure. Each unit is equipped with one adjustable clearance head to facilitate handling variable loads. By means of this device and the number of compresssion units a constant vacuum can be maintained on the suction side of the compressors.

Another interesting feature of the compression plant is the intake header connection designed to prevent condensation from accumulating in the line connecting the cylinder with the intake header. Vapor is taken from the top side of the header through a 180 degree tube turn and condensation is removed from the lower side of the header as it accumulates. As a safe guard against condensation on the top side of the valves in the suction lines to the compressor cylinders each valve is drilled and tapped above the valve disc. Too much emphasis can not be laid on these particular points since slugs of gasoline or water might seriously damage the compressors in starting.

In addition to these features each unit is equipped with a separate lubricator to feed castor oil to the compressor cylinders. This installation is made necessary due to the condensation of gasoline in the compressor cylinders. Castor oil is not miscible with gasoline and affords a very satisfactory means of lubricating the cylinder walls of compressors handling vapors of high gasoline content.

ABSORBERS

As previously stated, partial removal of the gasoline fractions from the vapors in a recovery system is effected by compression and condensation and the remainder by absorption in oil, redistillation and condensation. Hence, the absorber is probably the most important piece of apparatus in a recovery system.

In the Watson plant every care was exercised in the selection of an absorber which would give maximum yields of the useful gasoline fractions in the wasted vapors.

The tower selected was supplied by Engineering Research & Equipment Company according to the specifications of the Gas Department of Richfield Oil Company. It is a 16-plate bubble-cap absorber capable of handlinga maximum volume of 5,000,000 cubic feet of gas per day and a maximum oil circulation of 500 gallons per minute at 140 pounds per square inch gauge pressure.

A feature of particular interest in this absorber is the intercooler system for removing the heat of absorption from the absorption oil. In this system, there are five cooling sections located between the first, second, third, fourth, fifth and sixth plates of the absorber. They were supplied by Griscom-Russell Company and are known as "U" type "K-fin" cooling sections. They consist of an aluminum tube sheet fitted with "U" shaped aluminum tubes. Each tube is wrapped with an aluminum ribbon at right angles to the tube to form a heat collecting fin. This is made necessary due to the relatively low velocity of the oil across the tube and the frothy condition of the oil. Each section contains 406 square feet of effective cooling surface.

The sections are mounted on blank plates between the bubble plates and may be removed through a rectangular opening on the side of the tower. They are manifolded in parallel and connected to a closed water cooling circuit.

By means of these intercoolers the heat of absorption is removed as it is evolved and a more highly saturated fat oil is obtained. Too much emphasis can not be placed on this feature since the mean temperature of the oil in an absorber has a very definite effect on the extraction efficiency that can be obtained with a given oil-gas ratio.

Other benefits derived from the use of absorber intercoolers are the saving in the first cost of the oil circu-

lation, distillation and oil cooling facilities and the saving in operating expense.

PUMPING AND DISTILLATION SYSTEM

Oil and water circulation for the absorption plant is supplied by means of a General Electric-Cameron triple pump unit. A similar set of pumps direct connected to a Terry Steam Turbine serves as a stand-by for the electric unit. Each unit has a capacity of 1600 gallons of water and 300 gallons of lean oil per minute.

The distillation unit is composed of two Southwestern Engineering Corporation heat exchangers, a Southwestern Engineering Corporation steam preheater and an Engineering Research & Equipment Company combination stripper and fractionator.

Vapors from the fractionator are taken to the top of the water cooling tower where they pass through a primary box-type condenser composed of Griscom-Russell bent tube sections. From the primary condenser the condensate and uncondensed vapors pass into a reflux accumulator. The uncondensed vapor and excess condensate are taken to the final condenser and reflux is withdrawn from the accumulator and dehydrated by means of a water separator located on the ground level. Reflux is discharged over the top of the fractionator by the difference in elevation between the reflux accumulator and the top of the fractionator. This distillation circuit is designed to handle a normal load of 30,000 gallons of gasoline per day and is capable of handling a maximum of 50,000 gallons per day. The end point of the finished product is controlled by a Foxboro temperature controller set to maintain the proper temperature at the top of the fractionator.

The lean oil leaving the stripper is forced by the stripper pressure through one heat exchanger and is picked up by the lean oil pump and discharged through the two heat exchangers and Griscom-Russell bent tube cooling sections to the absorber.

Gasoline from the final condenser accumulates in a water separator equipped with Neilan Schumacher liquid level regulators and is discharged to two 4000-gallon vertical surge tanks. Gasoline from the accumulator scrubber and the final condenser is metered separately by means of American Liquid Meter Company meters. Vapors from the gasoline accumulator and storage tanks are taken through Neilan Schumacher back pressure regulators to the absorber and compression plants respectively.

STABILIZER

The stabilizer plant is composed of a 50-plate column, a kettle, a reflux condenser, a reflux accumulator and a heat exchanger. This apparatus was furnished by Southwestern Engineering Corporation according to the specifications.

Auxiliary equipment for this plant consists of Cameron simplex feed pumps, motor driven Westco reflux pumps, motor driven Cameron centrifugal water pumps, Neilan Schumacher motor valves, Neilan Schumacher liquid level regulators and Foxboro instruments and pressure gauges.

The plant differs from the usual installation in that no gasoline cooler is employed to cool the finished gasoline. The heat exchanger is designed to utilize the total amount of heat available in the finished product to heat the feed to the column. Under these conditions the gasoline leaves the heat exchanger at about 80°F. and requires no further cooling.

Control of the operation of the column is obtained by a differential feed controller, a differential reflux controller and a recording top temperature controller. The top temperature is maintained constant by regulating the amount of steam admitted to the kettle. This method of control is made necessary due to the variation in the composition of the feed during the day.

COOLING TOWER

The cooling tower employed in this plant is a 14-section "KKC-3" atmospheric Fluor cooling tower with a primary box-type condenser located on the top of the tower. Condensation in the primary condenser is secured by passing the entire volume of water, circulated over the tower, across and counter current to the stream of vapors. Water leaving the weirs of the condenser box passes through a common flume to three cross distributing troughs which feed the water to three lateral distributing troughs. Another feature of interest in this tower is the redistribution system. The water is collected half way down the tower and redistributed by means of cross collectors and redistributing troughs. This feature reduces the windage loss and increases the efficiency of the tower through uniform deck loading.

Griscom-Russell bent tube sections are mounted in the "C" or coil section of the tower to cool the gas and oil and to condense the gasoline and recompressor vapors. A collection and redistribution system is used to collect and redistribute the water over the Griscom-Russell bent tube sections. Each bay of the tower is equipped with easily operated gates to control the volume of water delivered to the cooling sections.

Under normal conditions with a five-mile wind this tower is capable of cooling 1600 gallons of water per minute from 88°F. to an average temperature of 70°F., or five degrees above wet bulb temperature. Loss of water due to windage is reduced to a minimum through the use of adjustable spray deflectors mounted on the lee side of the tower between the decks.

The over all dimensions of this tower are 28 feet wide by 91 feet long by 55 feet high. It is constructed of select California redwood lumber, brass bolts, copper nails and so designed that no guy wires are necessary.

This plant was erected by the Construction Department of the Fluor Corporation, Limited, according to the design of the Gas Department of Richfield Oil Company of California under the direction of H. R. Linhoff, manager.

THIRD ARTICLE

Factors Affecting Operation of Absorption Equipment

By I. N. BEALL
Chemical Engineer

THE major requisites for maximum efficiency are (1) good oil and (2) good equipment for intimate contacting of oil and gas. Assuming that as good oil has been selected as the efficiency of the fractionating equipment allows, the next problem is to provide means to properly use this oil to secure the greatest advantage. Disregarding for the moment the effect of temperature and pressure, the major factors of absorber design will be considered.

ABSORBER DESIGN

It will not be necessary to stress the significance of the absorber in relation to the other gasoline plant equipment, as the center of the system, the design and functioning of the rest of the plant is dependent upon its performance. Due to its important role, the absorber is worthy of the greatest care, both as pertains to design and operation.

Even though the purchaser may be interested only in specific performance, an understanding of the essentials in design in relation to effect on operation may serve as a guide for selection. It must be remembered that absorption rather than equipment is being purchased. An inefficient absorber is a poor investment at any price.

Laws for liquid and gas flow are applicable to absorber design. While it is always desirable to have data on actual operation upon which to base construction, invaluable insight into what may be anticipated can be gained by the use of approximating formulae.

The limiting capacity of an absorber is determined by its "puke." It is a matter of general observation among operators of absorption equipment, that a point is reached where an increase in either oil or gas volume will cause a shellful of oil to come over the top. Every absorber will do this if forced far enough, some more easily than others. The factors effecting this phenomena have been a matter of considerable conjecture. The following observations may cast some light upon the subject.

If one has had the occasion to observe a bubble tray in actual operation, the following may have been noted. First, there is the liquid level on the plate and then as the gas is slowly turned on, bubbling will start around one or two caps. As the gas is increased additional caps start to bubble, but a very considerable increase of gas is necessary before all the caps are working. The more nearly level the plate is, and the more nearly uniform the caps and their arrangement, the sooner all are working. Gas always follows the line of least resistance, therefore great attention should be taken to see that the paths of escape (vapor-uptake-pipes, and bubble caps) are as similar as is mechanically practical to construct. The cap of low vapor resistance in comparison to the other caps will throw oil above the average height for the plate.

As the volume of gas through a plate is increased after all caps are bubbling three distinct zones will be noted (1) a zone of froth or fine bubbles above the normal surface of the liquid with no gas flowing (2) a zone of oil spray thrown in all directions and (3) a zone of liquid mist or entrainment. These zones increase in height with an increase in gas until a point is reached where the velocity of the gas seems to suspend the body of the liquid above the plate. Such a condition of course seals off the plate above and the principle of the gas lift is brought into play, with disastrous results. The same applies when the second zone reaches the plate above regardless whether or not the oil has been lifted from the plate.

INCREASE OF OIL

After sufficient gas is passing to form the three zones already mentioned, an increase in oil will cause the same result to occur. This suggests that the oil level on the plate has something to do with the limiting capacity.

LIQUID LEVEL

If the liquid level is reduced by lowering the height of the overflow the "puking" point is moved up, and the highest oil-gas ratios are obtained when the notches of the caps are barely submerged. Depth of liquid beneath the rims of the caps seems to result in an unequal depth of zoning across the plates. The best conditions prevail as far as limiting capacity is concerned with a low liquid level on the plate and shallow caps submergence. It is well to remember when estimating depth of liquid

level on the plates that this level is increased by an increase in oil flow in accordance with the Francis Weir formula for flowing liquids $H=2/3\sqrt{\frac{3.33L}{V}}$ where V is volume of liquid (oil) in cubic feet per second, L is the perimeter of overflow in feet, and H is height in feet of oil level above the weir or overflow.

DESIGN AND DISTRIBUTION OF CAPS

The most efficient cap is one that for a given area, will divide a unit volume of gas into the greatest number of bubbles. Therefore, the most efficient plate, other things being equal will be one with a large number of small, square or rectangular caps in some system of uniform distribution. The rectangular cap of course has the larger periphery per unit of area, but the square cap is more amenable to distribution. Round caps are easier to make, and as a rule are of smoother design than either the square or rectangular shapes, which probably accounts for their widespread adoption. Less care has to be used in placing round caps above the vapor upflows, as there is less likelihood of channeling through the notches, because of better gas distribution. The greatest argument against round caps is that all points on the perimeter are at unequal distances from the neighboring caps. This causes channeling of gas through the oil between points in closest proximity. Round caps have a tendency to bubble in pairs. The maximum in plate efficiency is not possible to attain with this type of cap.

For equal sums notch area of caps per plate, other conditions remaining unchanged, the plate efficiency will vary as the 2/3 root of the number of notches assuming that all notches are operating equally. Thus for two plates equal in every respect with the exception of the total number of notches in the caps, say for illustration No. 1 has 1000 and No. 2 has 729, the relative efficiencies of the two plates would be in the ratio of $\frac{\sqrt[2/3]{729}}{\sqrt[2/3]{1000}}=\frac{81}{100}$ or No. 2 is 81 per cent efficient in comparison with No. 2. A large number of small caps, with a large number of notches per cap results in high plate efficiency, the unit area efficiency can be approximated by the use of the above formula. Triangular notches give greater absorber flexability for varying gas load. A sharp edge notch is preferably used as this tends to make smaller bubbles. An added refinement is to groove the notch in order to deflect the bubble toward the plate. This procedure causes velocity head to counteract the gas lift on the oil and results in higher oil-gas capacity.

In operation the gas from within the cap pushes the liquid level back until the liquid is below the points of the notches. The gas then has to overcome the head of oil above the point of exit, plus frictional resistance. This frictional resistance causes static pressure to be changed into velocity head. So far as the writer is aware there is no equation directly applicable to this type of flow, as the area of the cross section increases with the volume of gas flowing. However, a fair approximation of pressure drop per plate due to gas flow may be arrived at by multiplying the pressure drop through the vapor uptake pipes by 2. This equation is taken as that for the equation of flow for liquids and gases through restricted openings, $\sqrt{U_2^2-U_1^2}=C\sqrt{sq\ (\triangle h)}$, where U is taken as the velocity of gas through the free cross section of the absorber, U_2 is the velocity through the plate in feet per second, C is the orifice coefficient = 0.61 for sharp-edged orifices, G is acceleration due to gravity which is taken as 32.2 feet per second and $\triangle h$ is the pressure drop in expressed feet of gas and which may be reduced to any convenient terms such as inches of water or pounds per square inch if the actual density of the gas is known.

NUMBER OF PLATES

Increasing the number of plates in an absorber gives greater efficiency for minimum gas flow, thus lengthening the effective range. Inasmuch as efficiency of absorption is dependent upon intimacy of contact between oil and gas, which in turn is dependent, with due regard to other factors involved, upon the velocity of the gas in contact with the oil, plate efficiency is reduced at low velocities, therefore a larger number of plates are required. It is also true that a large number of plates will in some degree make up for deficiencies of design when operated under optimum conditions, but as a rule such conditions are not attained. If a wide working range is desirable for average needs, the best absorber will be one that has a high plate efficiency and a large number of plates. This will enable the operator to take care of sudden increases in gas, as well as provide for the declining gas supply. Twelve plates is a minimum requirement for average conditions.

Calculations and formula for the actual plate requirements can only be made where the individual plate efficiency has been determined. There is an efficiency gradient between minimum and maximum capacity.

SPACING OF PLATES

No harm can be done by increasing the distance between plates, other than adding to the initial cost of the equipment. Practice has set this distance around 18 inches. For well designed plates this distance should be ample, although the real effective distance should be between the top of the oil overflow to the bottom of the next plate, with due allowance for the rise in level caused by the flow over the weirs. In the above spacing a six-inch oil level plus one inch for overflow would leave only an effective distance of 11 inches. This would be working in too close quarters for high capacity, as under such conditions the absorber would have a tendency to "puke." In this case above a distance of two feet would be better.

LEVELING OF PLATES

Too much attention cannot be given this detail. If

a plate is not level conditions of unequal resistance are set up, and most of the gas will pass through the high side. Conditions of this kind tend to perpetuate themselves in continuous operation. The greater part of the effectiveness of a plate may be lost due to being off level. Plates should be of rigid construction, otherwise sagging may occur after the column is in operation.

OIL OVERFLOWS

The down-pipe area for oil from plate to plate should be at least three times that as calculated from the formula $Q = 4.4\ a\sqrt{h}$ where Q = gallons per minute, a = total area and h = head expressed as inches of oil. Frothing and gas lift effects cause a greater area requirement than that required for normal liquid flow.

From the standpoint of the upper limit in oil throughput, it is not only necessary that overflows have sufficient capacity to provide only for the oil, it is also necessary that the perimeter be adequate in order to prevent too high operating level from being carried on the plate. This is an important consideration as the adequacy of the overflow weir has a very marked bearing on the upper limit of oil capacity. The length of the perimeter is increased by various expedients such as the use of V weirs and rectangular or oval design pipes. Caps should not be placed directly against weirs, as this causes additional resistance and unsteady flow. It is advisable to blank some of the caps on the side facing the overflows.

LIQUID SEAL

Depth of liquid seal is dependent upon the pressure drop per plate and is figured at maximum gas capacity. The depth to which liquid will be backed up in the down drain, or underflow can be computed from the formula $h = \frac{V^2}{29C^2}$ where h is expressed in feet of vapor at absorber pressure. To get head in inches of oil $H\ oil = \frac{h \times Wt.\ cu'\ gas \times 12}{62.4 \times Sp.\ Cr.\ Oil}$. Multiplying the result obtained by 2 gives sufficient safety factor.

ABSORBER CAPACITY

The gas capacity of an absorber is computed from the highest allowable free space velocity. This is a variable quantity dependent upon design, and has to be determiner experimentally. It would seem as though in practice that the upper limit has not been reached. Increased pressure raises the upper limit of capacity, therefore estimates have to be based upon volumes under standard conditions (60°F. and 1 atmosphere). Free space velocity is expressed in cubic feet of gas per second according to the equation

$$\text{Velocity} = \frac{\text{Volume of Gas per day cu ft}}{.7854D^2 \times 86{,}400 \times Pabs}$$ where D is shell diameter and P is pressure in atmospheres absolute.

For a well designed absorber a free space velocity of two feet per second would not be too high. The average is somewhere between one and 1.6. The writer believes that this velocity can be greatly decreased, although from the standpoint of mechanical design the difficulties increase as diameter decreases. The upper limit of diameter is around 10 feet, six feet would be a better maximum, as it is best not to try to get too much or too little into one absorber. Vapor uptake for the plates area is estimated from the available notch area, which is somewhere between 10 and 15 per cent of the cross section. The vapor uptake area should equal about 90 per cent of the notch area per plate. Velocity head is dependent upon static pressure drop through the plate and cap. Where a higher pressure drop is permissible through the absorber, smaller vapor-up-take and notch areas can be used to advantage. The gas pressure drop through an absorber is computed from the velocity head per plate, the cap submergence and the overflow head times the number of plates.

MIST EXTRACTION

Fine drops of oil are carried in a continual stream from the absorber by the gas unless some means are provided for removal. Baffling devices have been devised for this purpose, a satisfactory scheme is to place small Raschig or Lessig rings to a depth of 12 inches or more on a grid situated just below the exit. The purpose is to provide surface and to impart a whipping action to the gas by passage through a tortuous route. This results in a coalescence of the minute droplets.

DISTRIBUTION OF OIL ENTERING ABSORBER

The distribution of oil as it enters the absorber is a matter of some importance. In order to insure the same uniform distribution as persists throughout the lower plates, a chamber should be provided for the oil to enter, and from this chamber down pipes similar to those used between plates. The top plate is of especial importance in that the final equilibrium between gas and lean oil is established there. Such apparently insignificant details as this have a decided bearing on absorber efficiency.

DISTRIBUTION OF GAS

Velocity head is transformed into static head as gas passes from the main into the absorber. The pressure drop is greater just around the point of entrance and gradually fans out. This may upset the action of bottom plate. Distributing manifolds with the openings facing away from the plate avoid this possibility.

MISCELLANEOUS

Liquid level is maintained at the bottom of the absorber by means of a float actuating a valve in the out-

(*Continued on Page* 110)

Designed for High Pressure and Convenient Operation

By GEORGE REID
Associate Editor

COLUMBIAN Gasoline Corporation in the fall of 1929 completed construction of its newest north Louisiana natural gasoline plant, located about two miles northwest of Alto, Louisiana, in the Richland Parish section of the Monroe gas area. This plant was designed to treat 50,000,000 cubic feet of gas daily at a pressure of 400 pounds per square inch, and to extract gasoline from the gas at a rate of from 12,000 to 16,000 gallons each day. The plant is of latest modern type and is therefore practically automatic in its operation. Much thought was given to its lay-out with a view to securing compactness and at the same time to arrange equipment which must be supervised in its operation for the convenience of the operators, at the same time bearing in mind the hazards of gasoline plant operation and tending to overcome these by safe distancing of the power house, absorbing, distilling, rectifying, cooling and final storage equipment.

In this discussion of the plant the different departments are taken up in the order of their importance, starting with the installation of six Ereco absorbers designed for the treatment of 50,000 cubic feet of gas daily. These absorbers are four feet in diameter and are provided with 16 trays of bubble type. Orifice plates are provided on each of the six gas inlet lines as well as on each of the absorption oil inlet lines. Through the use of an equalizing header two inches in diameter connecting all six absorbers together with the feeder lines extending to about one foot above the oil level in the absorbers, the liquid level control of all absorbers is secure through the use of but one Neilan-Schumacher control instrument. The liquid level controller works off of the pressure equalizing line and the bottom of the control works off of the absorption oil outlet header line.

The absorption oil used at this plant is a narrow cut of 42 gravity having a 350 initial boiling point and about 450 final boiling point. Absorption is carried out under gas pressure of 400 pounds. The absorption tower installation is provided with centrifugal gas scrubbers on the gas inlet and gas outlet.

Oil, after enrichment, is taken from the absorbers under operating pressure to the nearby vent tank. Here a Neilan Schumacher remote control motor op-

Absorption, distillation and fractionating equipment at Columbian Gasoline Corporation's latest gasoline plant, near Alto, Richland Parish, Louisiana

Details of equalizing header installation and single liquid level controller regulating six absorbers operating at 400 pounds pressure

erated diaphgram valve works on the oil from absorbers to vent tank. Under a pressure reduced to 110 pounds, the rich oil flows from the vent tank through heat exchangers preheaters, through the still, through the oil coolers and into the lean oil tank. The venttank is provided with regulating devices which cause the oil to stop flowing either at 105 pounds or 115 pounds pressure. Gases from the vent tank are regulated in their flow from this point into the re-absorber equipment.

The vent tank operates at 110 pounds pressure and rich oil going to still is reduced to 20 pounds pressure

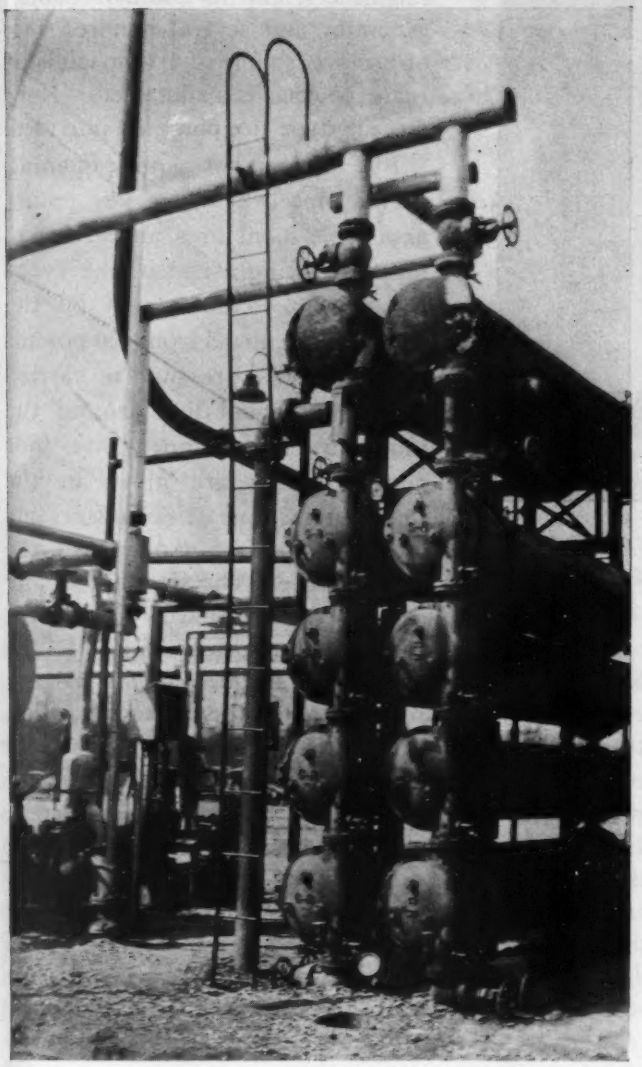
In addition to the gases from the vent tank the reabsorber is also employed to absorb the valuable constituents from gases and vapors from the various gasoline storage tanks. A vapor line from the reabsorber is brought down to a horizontal tank or trap where any absorption oil mechanically entrained may be removed and reclaimed. In this manner the gas from the reabsorber is cleaned. This gas is then taken to the plant yard and used in place of air for jetting the plant water wells. From the wells these gases are accumulated and conducted to the boilers and consumed as fuel. Thus it may be said that this plant provides part of its own fuel from its own operation.

The distillation equipment consists of a 48-inch diameter Ereco combined still and rectifier, having 16 active bubble plates with a water separating plate and oil collecting plate. Eight of the bubble plates are in the stripping section and eight plates are placed in the rectifying section. All of the heat transfer equipment is Griscom Russell type.

Distillation is carried on under 50 pounds pressure. Rich oil leaving the vent tank is reduced in pressure to 70 pounds before it enters the eight G-R. exchanger sections and the two preheater sections. Foxboro automatic recording controller device regulates the temperature at the top of the still through the control of reflux pumps. Live steam is employed in the preheater sections and in the still heating element. Water condensed in this heating equipment is conducted to a water accumulator and a liquid level control instrument regulates a steam operated pump which removes the water back to the boilers.

Vapors from the still are passed through two Bentube sections which are controlled to produce natural reflux of about 140° F. The remainder of the uncondensed vapors passes from a combination reflux accumulator and dewatering tank through a third Bentube section, through condenser sections and to run-down storage. From the run-down tanks the gasoline is

Combination reflux accumulator and dewatering tank with level controls



Heat exchange and preheating equipment

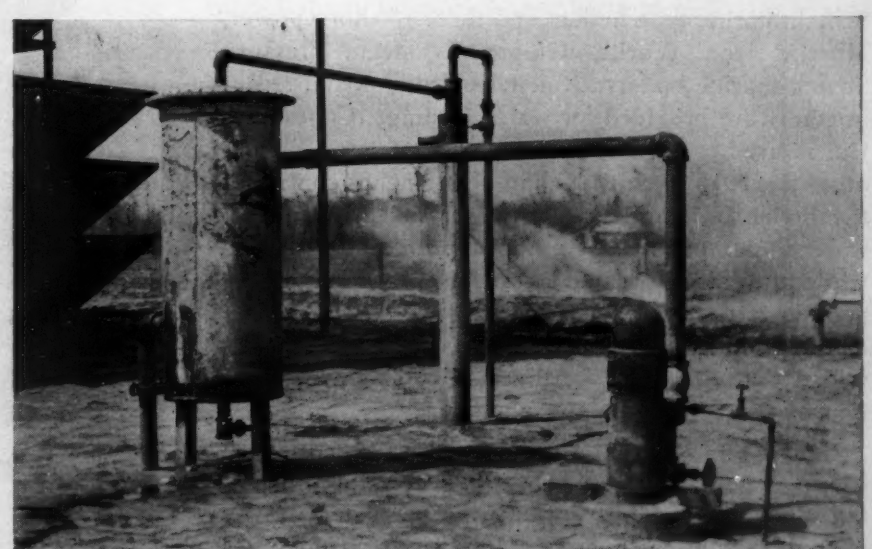
automatically trapped into the storaeg tanks and the vapor from run-down tank is put through the small re-absorber. The run-down tank and reflux accumulator tanks are provided with automatic liquid level control devices and with relief devices set at pressures slightly higher than normal operating pressures which provide a means of venting in the event anything goes wrong.

Lean oil from the stills is taken to a horizontal accumulator or surge tank after passing through G. R. sections in the Fluor cooling tower. The lean oil pump takes suction at this point discharging back through the absorber, vent tank, exchanger, preheater and still system. Automatic control is provided the surge tank which causes the pump to shut off in the event of loss of suction, as a safety measure. The cooling tower mentioned in connection with the oil cooling sections is constructed of redwood with brass anchor bolts and fastenings. The lower louvres are enlarged in dimensions in such manner that most of the windage losses from the upper louvres is caught and saved, in the event such losses occur.

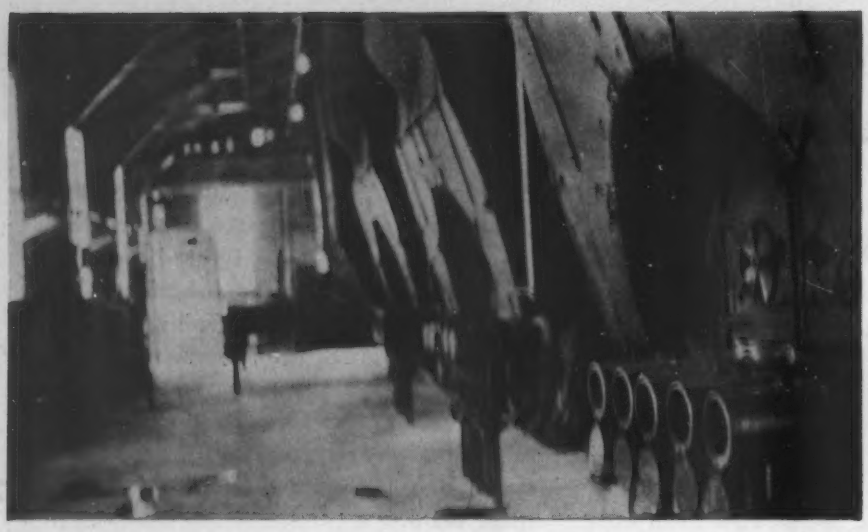
The pump house and control house is centrally located, constructed of iron sheeting over steel framework, with concrete flooring, well lighted and ventilated. The pumping equipment is standardized Dean Brothers equipment consisting of three high pressure oil pumps for handling absorption oil, size 14 by 6¼ by 12. Five cold water pumps are provided for cooling water all size 12 by 12 by 12. Two close clearance gasoline transfer pumps are provided for loading purposes, being size 10 by 5 by 12. Two simplex pumps are installed for feeding gasoline to the fractionating column and two pumps for handling reflux to the still which are also simplex type. In addition two pumps are installed for pumping fat oil from the re-absorber. In each instance one pump is an auxiliary unit. All pumps are steam driven. In the same building the recording or indicating devices of the control instruments are grouped on a control board.

FRACTIONATING EQUIPMENT

The fractionating column is 24 inches in diameter. Ereco type, and all of the production is put through this column and the undesirable constituents rejected in order to produce a stable grade AA product which is propane free. The fractionator operates continuously and the gasoline is pumped into it at approximately the same rate that the finished product is removed. A Foxboro differential recording controller is employed in control of the fractionator temperature. Operating at 170 pounds pressure the raw gasoline is charged through G. R. exchanger and into the column at any one of three points of entry, or at the point of lowest temperature. There are 24 bubble trays in the column. Gasoline from the re-



Connections at one of the plant water wells where uncondensible gases are used to jet the water and are later consumed under the boilers



Interior of power house. Fires under boilers can be extinguished from seven points about the plant yard. The boilers are fully automatic in control

boiler section passes through the exchanger system heating this raw charge to 180° F.

Gasoline charged to the column drops downward to the bottom of the column and into the reboiler, which is held at the operating temperature of 240° F. by the use of live steam. Leaving the reboiler and exchangers the finished product is conducted to one cooling section in the cooling tower and to finished storage. Reflux material is circulated into the top tray of the fractionating column and from there to condenser and back to the column. The tower-top temperature is held at 130° F.

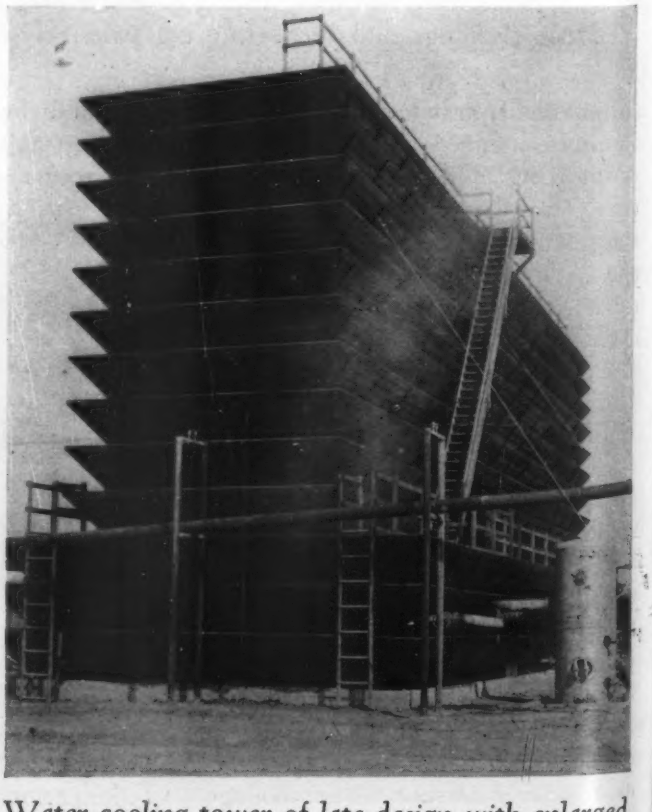
The final product is loaded at a company-owned loading rack seven miles distant at Archibald. This line is 2½-inch all welded line, buried three feet underground.

In the power house there are two 100-horsepower Hedges, Walsh, Weidner, 200-pound steam pressure Scotch marine type boilers and three 150 horsepower, Murray Iron Works, 125-pounds steam pressure Scotch marine boilers. Boiler feed pumps and steam injectors are provided for water feeding. Copes control is used on two boilers and Kitts control on the other three, along with Neilan-Schumacher control of the boiler feed pumps. Through this arrangement water is pumped by one pump to both sets of boilers while they are operated at 180 pounds and at 115 pounds respectively. The heavy type steam driven Epping-Carpenter boiler feed pumps are so manifolded that they may be diverted to the water system of fire control on the plant yard.

In the power house there is also a Worthington 200-horsepower open feed water heater for preheating boiler water. For lighting the plant and nearby employees houses there is a 10-kilowatt Kohler gas engine driven generator and a 10-kilowatt Westinghouse steam driven generator.

The plant is amply provided with Fomon fire extinguishers, and in addition Fomon generator and several hundred feet of hose. A supply of 1000 pounds of foam powder is maintained. Non-freezing type fire plugs are provided.

By means of quick-opening valves placed at seven key points about the plant fires under boilers may be extinguished in the event of accident to equipment on the yard. Gas reduced from 400 pounds to 50 pounds pressure is carried through a small line around the plant in such manner that four control points are given in the pump house, one at the office, one at the absorbers, and two at the boiler house. The shutting of any of these valves causes a regulator to shut off the flow of gas to the boiler fires. By actual test at the time of the writer's visit, the fires were cut out of the furnaces within 10 seconds after the whistle had blown. Records on certain charts show what men turned these safety station valves and how many of them were turned. In the instance referred to the boiler fireman and the control house operator both shut control valves, and all three operators were concentrated at the pump house at once. Within 2½ minutes fires were again going in the boiler furnaces. Plant operation was uninterrupted.



Water cooling tower of late design with enlarged lower section to reduce water losses

Chemical Treatment of Petroleum Distillates

II. Sulphur:—Forms—Effects—Removal

By L. J. CATLIN
Chief Chemist, The Standard Oil Company (Kansas)

SULPHUR is by all odds the most offensive impurity with which the petroleum industry has to deal. It begins at the well where hydrogen sulphide gas is a hazard to drillers; continues in the storage tanks where it corrodes equipment, endangers gaugers, and leaves compounds capable of spontaneous combustion; extends throughout pipe line systems; and appears with increased intensity at stills and rundown tanks at refineries; and finally requires chemical treatment for removal. Other sulphur compounds of more stable nature defy all ordinary methods of treatment and are passed on to the consumer where under certain conditions they may again become corrosive. One of the prime purposes of chemical treatment is the control of the character and amount of sulphur in the finished product, making it as inoffensive as possible, and reducing the amount to as small dimensions as is consistent with cost.

Practically all specifications set a limit in the amount of sulphur allowable. The effect of sulphur compounds on equipment in which gasoline and kerosene are used is a debatable question. It is known that sulphur combined with oxygen, as in burning, is acid-forming, but water is necessary to complete the acid to sulphurous or sulphuric acid. Water is also formed in all combustion where hydrogen is burned, so that all the necessary elements for the formation of corrosive acids are present. These acids, however, are not effective till they are condensed to liquid form and this seldom has a chance to take place before the products of combustion are discharged from the equipment in which they are burned. During starting of motors, especially in cold weather, some moisture carrying acids may condense within the cylinder, and in the case of leaky rings, run down into the crankcase where the acids cause corrosion and the water may freeze in the oil lines, etc. The portion of the moisture which remains in the combustion chamber will of course be evaporated as the engine warms up and do little damage. In the case of kerosene it is thought that sulphur effects the amount of stain on lamp chimneys and incrustation on wicks, but other things probably enter into this problem to even greater extent than the percentage of sulphur unless this is excessive. Whatever these things are they are usually corrected by any treatment which keeps the amount of sulphur comparatively low, so that this specification suffices as a general criterion for judging chemical treatment of kerosene.

ELEMENTARY SULPHUR

This of course means sulphur in the form of an element, that is, not combined with any other elements. It is also referred to as free sulphur because it is merely dissolved in the oil, and as corrosive sulphur because it so readily attacks clean metal surfaces. It is found in crudes only from certain localities where presumably there are deposits of sulphur. It is frequently found in treated gasoline and kerosene due to excessive use of sulphur in the doctor reaction. This is inexcusable. When distillates containing free sulphur are exposed to light, and perhaps in a much slower degree when not so exposed, free sulphur is oxidized and the acid thus formed produces a sludge in the oil the same as sulphuric acid would do. In small amounts, the sludge remains dissolved in the oil causing it to go off color, while in larger amounts it may settle out and can be readily separated out and proven by test to contain sulphuric acid.

The ordinary test for elementary sulphur is the copper strip test. A polished copper strip is placed in a test tube containing the oil to be tested, and heated for one half hour at 212°F., or for three hours at 122°F. If elementary sulphur is present the strip will be discolored anywhere from brown to black, depending on the amount present. Several precautions are necessary in making this test at the treating plant. In the first place all hydrogen sulphide must first be removed as it will produce the same effect. In the second place all moisture or suspended doctor must be removed by filtering or they will interfere with the test. Discoloration on the copper due to caustic in doctor will have a purplish tint instead of the dull brown or black of the free sulphur. In the case of pressure distillate and longer periods of boiling, some gum may be deposited on the copper causing discoloration similar to free sulphur. Another peculiar case is where doctor fails to settle out and will not even filter clear; the oil should show discoloration enough to warn of this case, but in the case of pressure distillate it may escape notice.

In the test a discoloration of the copper will be found

due to the doctor present, and oddly enough the correction necessary is addition of more sulphur to complete the separation of the doctor from the oil. Free sulphur which has been oxidized to sulphuric acid as mentioned above, will of course not show up in the copper strip test. Buyers of gasoline often allow for this fact when taking samples from tank cars for this test, by using colored bottles to prevent the disappearance of small quantities of free sulphur while carrying samples from the car to the laboratory. This will be discussed further in connection with the doctor reaction.

HYDROGEN SULPHIDE

Hydrogen sulphide (H_2S) is a gas and is highly soluble in oil. As a gas it is heavier than air, (Sp. Gr. 1.19), has a very offensive odor, and is extremely poisonous. Its toxic properties have been studied by various investigators. Results obtained by the Bureau of Mines and reported in Bulletin 231, (1925), are perhaps typical. After experiments with various animals and with men, the conclusion is that concentration as low as .01 per cent of H_2S in air may be fatal if continued from eight to 48 hours. This concentration becomes irritating to eyes and respiratory passages in from two to 30 minutes. Concentrations as high as .05 per cent may cause collapse and even prove fatal in less than two minutes. Precautions are necessary at all places where untreated products are handled, such as gauging of tanks, in receiving houses, etc.

Oils containing dissolved hydrogen sulphide do not retain them completely, but are constantly giving them off, if the portion given off is allowed to escape, thus changing equilibrium conditions. When completely saturated, oils may contain as much as three or four volumes of gas to one volume of oil; on the other hand, with free outlet for escaping gases, practically all may be given off. This is especially true with the light distillates. This makes possible saving of chemicals in the case of distillates which may be air blown without excessive evaporation losses. Kerosene distillate may be almost completely freed from H_2S by air blowing in an agitator. It is also highly soluble in water, ranging from four parts of gas to one of water at low temperatures, to a little less than two at higher temperatures. Obviously, water washing may also be used and the lower temperatures are the better. Chemical methods on a commercial scale are confined mostly to the use of caustic solutions, while for testing purposes metallic salts, such as lead acetate, cadmium chloride, etc., may be used.

In the distillation of petroleum, hydrogen sulphide is of course always carried over with other vapors. Thus in crudes bearing it in dissolved form it is all driven out with the distillates, much of it remaining with the permanent gases. Other sulphur forms contained in the crude are also changed partially to hydrogen sulphide by heating so that the amount given off is actually higher than that carried in solution. Hence treatment of crudes before distilling cannot be relied on to eliminate this gas.

As already mentioned, hydrogen sulphide is very corrosive to most metals. It is most corrosive however, at lower temperatures where it may be dissolved in condensed moisture, or at high temperatures, above 500°F. when it combines directly with iron. In rundown and storage tanks another hazard appears from the fact that the iron sulphide scale which forms on roofs and other surfaces is capable of spontaneous combustion when air is admitted in sufficient quantity as when tanks are emptied. When the proportion of air and hydrocarbon vapors is within certain ranges this may lead to violent explosions. In removing coke from tube stills considerable iron sulphide scale also comes from the tubes, and this ignites spontaneously when piled in open air. When lime is used to prevent corrosion of tubes it becomes calcium sulphide and acts similarly when exposed to the air with coke and other oily products.

In the case of crudes giving off large amounts of hydrogen sulphide it is often necessary to resort to chemical treatment while still in the vapor lines for its removal in order to minimize these troubles. Water washing as with jet condensers, or washing with caustic solutions, or introduction of ammonia gas, are methods used for this purpose.

ORGANIC SULPHUR

As already stated, this term refers to compounds in which sulphur, combined with carbon and hydrogen, forms compounds similar to the hydrocarbons of which the oil is composed. These may of course range from volatile liquids to semi-solids or solids dissolved or suspended in the oil. Quite a number have been identified and many others have been postulated as likely to be found. The effect of these organic compounds upon treating problems has for the most part been studied by preparing solutions, using purified hydrocarbons with additions of known amounts of the different sulphur compounds likely to be found in petroleum. In some cases the formula for the reaction has been written and certain easily observed characteristics of the reaction have made possible quantitative, as well as qualitative chemical control by the treating plant operator. In other cases the results of treatment can only be known by making determinations for total sulphur before and after treatment. This is of course strictly a laboratory task and requires more time.

For practical purposes the organic compounds may be grouped as mercaptans, with the general formula RSH; sulphides, R_2S; and disulphides, R_2S_2; in which R represents hydrocarbon radicals, varying in structure and composition in a manner similar to the various series of hydrocarbons found in petroleum. The mercaptan group is the one most familiar to the treator as it is the one with which doctor treatment is mainly concerned. Other groups studied with respect to reactions with ordinary refining agents include thiophene, sulfones, sulphates, sulphonic acids, and carbon disulphide. The relation of treating plant operation to these groups will be discussed in connection with different types of chemical treatment.

(Continued on page 147)

Need for Lower Still Runs Shown by Economics Committee

CRUDE runs to stills during 1930 will necessarily have to be reduced three per cent under last year, if the industry expects to attain any degree of stabilization. This is the conclusion obtained from the facts presented in the report of the Committee on Petroleum Economics, appointed by Secretary of Interior Wilbur. The committee, consisting of J. Elmer Thomas, chairman, Joseph E. Pogue, secretary, and Ray M. Collins, H. W. Lowrie, Jr. and H. P. Grimm, made a thorough, unbiased study of the oil situation, the results of which are presented, in part, as follows:

The 1930 demand for gasoline is estimated to be 476.7 million barrels, an increase of nine per cent over the 1929 demand. This quantity of gasoline can be supplied from a domestic crude oil production of 942.8 million barrels, or 2,583,000 barrels per day, if the output of cracked gasoline is 161 million barrels and there is a moderate draft on stocks of gasoline and of fuel oil. This schedule calls for refinery runs of 957.8 million barrels, or 2,624,000 barrels per day. The domestic crude oil requirement of 942.8 million barrels, introduced into a balance sheet of total supply and demand, indicates that this quantity is sufficient to meet the expected demand for all oil, with a draft of 30.1 million barrels on over-all stocks. The domestic crude oil requirement has been allocated to the principal producing areas for the last nine months of 1930 as follows, in thousands of barrels per day: California, 610; Oklahoma, 655; Texas, 750; all others, 480; from storage, 78; and total United States, 2573.

TABLE 1
Estimated Demand for Gasoline in 1930

Year	1 Cars carried over from previous year T	2 Production of cars in U. S. T	3 Exports of cars T	4 Total new cars added during year T	5 Cars registered during year T	6 Cars eliminated during year T	7 Cars in use end of year T	8 Average number cars in use during year T
1925	16,116	4266	428	3838	19,954	1861	18,093	17,104
1926	18,093	4301	393	3908	22,001	1803	20,198	19,145
1927	20,198	3401	466	2935	23,133	2416	20,717	20,457
1928	20,717	4359	583	3776	24,493	2472	22,021	21,369
1929	22,021	5358	745	4613	26,634	3100a	23,534a	22,777a
1930a	23,534	4250	600	3650	27,184	2800	24,384	23,959

Year	9 Average number cars in use during year T	10 Consumption per car b/ B	11 Domestic consumption of gasoline MB	12 Per cent change	13 Exports of gasoline MB	14 Per cent change	15 Total gasoline consumption MB	16 Per cent change
1925	17,104	13.2	226.5	...	31.5		258.0	...
1926	19,145	13.8	264.9	+17.0	43.3	+31.5	208.2	+19.8
1927	20,457	14.7	300.4	+13.4	44.3	+ 2.3	344.7	+11.8
1928	21,369	15.6	332.5	+10.8	52.9	+19.4	385.4	+11.9
1929	22,777	16.5	376.2	+13.1	61.2	+15.7	437.4	+13.5
1930a	23,959	17.1	409.7	+ 8.9	67.0	+ 9.7	476.7	+ 9.0

T—Thousands of units (cars and trucks).
B—Barrels of 42 gallons.
MB—Millions of barrels.
a—Estimated.
b—Other uses of gasoline included in this ratio.

FORECAST OF DEMAND—GASOLINE

The demand for gasoline is dependent upon three indeterminate variables, namely, the number of automotive units in operation, industrial conditions and the weather. Table 1 lists statistics on automotive units for the past five years with an estimate for 1930. Data on past gasoline consumption per car is given and a forecast made for this year. The resultant figure, 409.7 million barrels, is taken as the total domestic gasoline consumption. Exports of gasoline were predicted by extending the trend of recent years and modifying the result according to the best information available. This figure, 67.0 million barrels, makes our forecast for total gasoline demand 476.7 million barrels, an increase of 9.0 per cent over 1929 demand.

An error of only one per cent in the forecasted rate of increase amounts to 4.37 million barrels of gasoline which, reflected back to domestic crude oil, represents a difference of 48,000 barrels daily in requirements. For this reason forecasts for a full year in advance are most difficult and are usually modified monthly as new statistics are available. An error of five million barrels, however, could be compensated from gasoline stocks without affecting crude oil requirements.

GAS AND FUEL OIL

The statistics on gas and fuel oil are not sufficiently exact to permit a close calculation of requirements or supply. Consumption is taken to be production and imports plus or minus changes in stocks, but there are inconsistencies in the available statistics, which are now being corrected. The committee forecasts a demand of 456.0 million barrels for gas and fuel oil, approximately last year's consumption, but this matter is so dependent upon cracking operations that the subject will be treated more fully later.

OTHER REFINED PRODUCTS

Without a close examination of the probable demand for other products it is a fair assumption that a slight increase may be expected in the less important petroleum products. The committee has used 130.0 million barrels as the 1930 demand for them.

CRUDE EXPORTS, ETC.

Various other items, such as crude exports, refinery losses, crude used as such, etc., enter into the demand for petroleum products and estimates have been given for each of them in Table 3. None of these items varies sufficiently to affect the required crude supply, as does the demand for gasoline and fuel oil, so that in any

TABLE 2

Analysis of Demand Showing Method of Determining Domestic Crude Oil Requirement in 1930

(In millions of barrels)

	1	2	3	4	5
	1927	1928	1929	1930 (Est.)	Per Cent change 1930 from 1929
1. Domestic consumption, gasoline	300.4	332.5	376.2	409.7	+8.9
2. Exports, gasoline	44.3	52.9	61.2	67.0	+ 9.5
3. Total demand, gasoline	344.7	385.4	437.4	476.7	+ 9.0
4. Output, cracked gasoline	101.2	122.5	143.7	161.0	+12.0
5. Natural, gasoline blended	33.2	36.5	46.7	53.0	+13.5
6. Benzol blended	2.6	2.8	3.1	3.3	+ 6.5
7. Imports, gasoline	5.0	4.2	8.9	14.0	+57.3
8. Output, straight-run gasoline	197.0	219.2	245.0	240.4	— 1.9
9. Total gasoline supply.	339.0	385.2	447.4	471.7	+ 5.4
10. Change in gasoline stocks	—5.7	—0.2	+10.0	—5.0	...
11. Per cent recovery, straight-run gasoline	23.8	24.0	24.8	25.1	+ 1.2
12. Crude oil charged to stills	828.8	913.3	987.7	957.8	— 3.0
13. Crude oil exported, consumed as such, etc.	54.7	50.6	47.0	54.0	+14.9
14. Total crude oil required	883.5	963.9	1034.7	1011.8	— 2.2
15. Less imported crude oil	58.4	79.8	78.9	69.0	—12.5
16. Domestic crude oil required	825.1	884.1	955.8	942.8	— 1.4
17. Domestic crude oil production	901.1	901.5	1005.6	....	
18. Change in crude oil stocks	+76.0	+17.4	+49.8	....	

TABLE 3

Balance Sheet of All Oil Showing Effect of Limiting Crude Oil Production to the Requirement Estimated in Table 2

(In millions of barrels)

Supply of All Oil

	1	2	3	4
	1927	1928	1929	(Est.) 1930
Crude produced in U. S.	901.1	901.4	1005.5	942.8[1]
Natural gasoline[3]	38.6	42.3	52.3	58.0
Benzol	2.6	2.8	3.1	3.3
Imports, crude oil	58.4	79.8	78.9	69.0
Total supply, all oil	1014.1	1038.1	1169.6	1120.6

Demand for All Oil

	1	2	3	4
	1927	1928	1929	(Est.) 1930
Gasoline	344.7	385.4	437.4	476.7
Gas and fuel oil[2]	386.7	428.4	456.0	456.0
Kerosene	57.0	58.3	57.3	57.0
Lubricants	31.5	34.2	34.5	35.0
Crude—as—such	60.6	50.5	48.1	53.0
Refinery losses	28.4	29.0	35.1	35.0
All others	35.1	29.6	33.6	38.0
Total demand, all oil	944.0	1015.4	1102.0	1150.7
Total supply, all oil	1014.1	1038.1	1169.6	1120.6
Change in stocks, all oil	+70.1	+22.7	+67.6	—30.1

[1]Estimated domestic crude oil requirement.

[2]All fuel oil figures are approximations because of limitations inherent in the statistics.

[3]Total output of natural gasoline including that blended at refineries and otherwise used.

ordinary refinery operations the demand for them will be met.

ESTIMATES OF SUPPLY—GASOLINE

Reference to Table 2 will show how the estimate of the crude oil requirement has been developed. Of great importance is the volume of gasoline furnished by cracking operations. This comparatively new development is a forward step from the standpoint of conservation, furnishing as it does a larger per cent of crude converted into its higher and noncompetitive uses as against its lower and competitive uses.

CRACKING OPERATIONS

Recent years have exhibited a steady increase in the volume of cracked gasoline, the per cent yield from cracking operations and the total per cent gasoline recovery from crude, but this tendency appears to be pointing to a limit for large increases in gasoline supply unless an important reduction is witnessed in the consumption of gas and fuel oils. Full utilization of cracking facilities will tend to over-produce gasoline if increases continue in fuel oil consumption; conversely, the amount of crude necessary to meet the gasoline demand, with increasing cracking operations and growing supplies of natural gasoline, will tend to under-supply gas and fuel oil markets as now constituted.

The statistical position of the oil industry in 1930 would seem to dictate a slowing down in the rate of increase in cracking to permit some reduction in gasoline inventories and our estimate for gasoline from cracking stills has been placed at 161.0 million barrels. This may be altered somewhat by any changes in the price spreads between crude oil, charging stocks and gasoline, price having a notable influence on cracking operations.

To the extent that price increases encourage the operation of cracking units the interests of conservation are served in two ways: the demand for crude is diminished and its higher uses are realized. Lower price levels on narrowing spreads tend to discourage cracking operations, call for more crude and provide a larger volume of fuel oil. This factor merits considerable attention because it is one of the most important economic influences affecting the industry today.

NATURAL GASOLINE

The output of natural gasoline, which is relatively independent of demand, likewise has shown sharp increases and we estimate the total 1930 supply at 58.0 million barrels of which 53.0 million barrels will be blended at refineries and 5.0 million barrels sold direct. Since it is a by-product of gas production, the rapid growth of the natural gas industry suggests that these increases will continue. Each million barrels of natural gasoline displaces 4,000,000 barrels of crude for straight-run operations and it has therefore an appreci-

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able effect upon crude oil requirements, its influence likewise being along lines of conservation.

OUTPUT OF BENZOL

A small quantity of benzol is employed by refiners for blending purposes. This item shows a steady growth, but the volume is nominal.

IMPORTS OF GASOLINE

Imports of gasoline in 1929 doubled as compared with 1928, and 1930 imports, according to best available information, are expected to increase 5.1 million barrels, or 57 per cent. The committee estimates that 14,000,000 barrels of gasoline will be brought into the United States in 1930, largely from Venezuela, and that this volume will represent 2.94 per cent of the total 1930 demand for gasoline.

GASOLINE STOCKS AS A SOURCE OF SUPPLY

The remaining demand for gasoline, not met by supply from the sources discussed above, must be supplied from stocks or from straight-run distillation of crude oil. Before determining the quantity of crude oil required to meet efficiently the total demand, consideration must be given to the question of how much gasoline can be withdrawn from inventories.

The gasoline stocks carried over into 1930 were larger by 10,000,000 barrels, or 30 per cent, than the carry-over into 1929, which indicates that present stocks are excessive. Both evaporation and carrying charges represent a loss to the industry and to the public. Accordingly, it would seem desirable that they be reduced. From the point of view of necessary working reserves the evidence suggests a surplus of 10,000,000 to 15,000,000 barrels. Attention must be given, however, to the possible effect upon fuel oil stocks would result from such a drastic reduction.

Gasoline stocks can be liquidated by reducing crude run to stills. Every million barrels of gasoline derived from storage displaces four million barrels of crude run to stills and reduces the output of fuel oil by 1,650,000 barrels. Using the approximate statistics available for fuel oil, it may be computed that a draft of 15,000,000 barrels on gasoline stocks, assuming the refining schedule as set up in Table 2, would involve a total withdrawal of about 42,000,000 barrels from fuel oil inventories.

After careful consideration of this gasoline-fuel oil relationship the committee has allowed for a reduction in gasoline stocks of only 5,000,000 barrels. This should not disturb fuel oil committments and local fuel oil requirements in any part of the country. California, however, with the heaviest stocks of fuel oil, could increase materially our allowance both for gasoline and fuel oil withdrawals and the committee has information indicating that such a program is contemplated. Should this eventuate, a further reduction in storage will occur, which the committee feels will greatly benefit the situation.

STRAIGHT-RUN GASOLINE

The volume of gasoline required from straight-run refining is computed to be 240.4 million barrels, a reduction of 1.9 per cent below 1929 requirements. This balances the forecast of total gasoline demand for 1930 to be met from all sources.

CRUDE OIL REQUIREMENTS

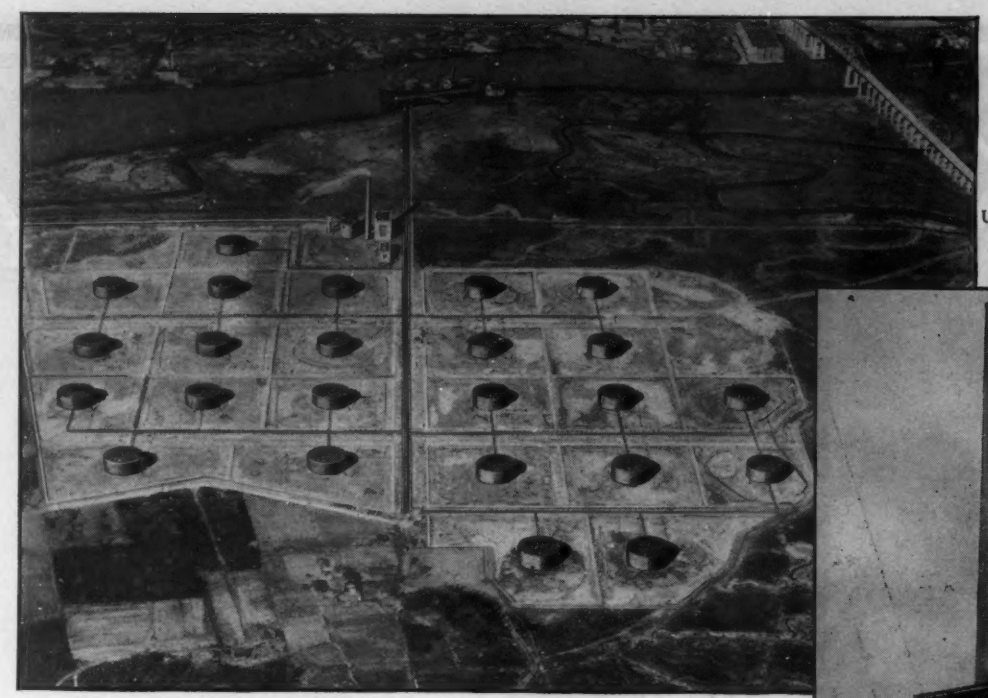
To estimate the crude oil requirements of 1930 is one of the major purposes of this inquiry and this figure now can be computed.

CHARGES TO STILLS

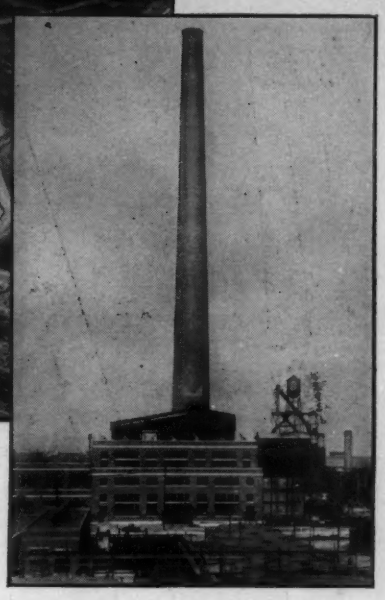
Reference to Table 2, Line 11, shows the steady increase from year to year in the recovery factor of straight-run gasoline from crude oil. This is due in part to technical improvements in refining and in part to gradual betterment in the quality of crude oil production. Both influences are still operating but the trend will be checked by the tendency of refiners to make higher quality (lower end-point) gasoline.

For 1930 the committee estimates a recovery factor of 25.1 per cent, only slightly higher than the 1929 figure. Using this factor, the estimated quantity of gasoline needed from straight-run operations will require charges to stills of 957.8 million barrels, or 2,624,000 barrels per day, a decrease of 3.0 per cent from the crude charged in 1929. No decrease would be necessary, however, if crude had not been over-run in 1929.

H. W. LOWRIE H. P. GRIMM J. ELMER THOMAS JOSEPH E. POGUE RAY M. COLLINS



BULK STORAGE PLANT
Staten Island



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Low Pressure Exhaust Steam Used in Process Work

By GEORGE REID
Associate Editor

LOW pressure steam for process work at the No. 2 Refinery of the Pennzoil Company, Oil City, Pennsylvania, is derived from the operation of the cracking unit pumps. The use of exhaust steam from large pumps for process work in other departments is an example of utilization of waste heat, or low pressure steam, which in many instances is not deemed of sufficient importance to use, is a commendable practice, as it secures better economy of plant operation, and effects the consumption of steam which is otherwise wasted.

At the Pennzoil plant the Dubbs cracking units of 1000-barrel capacity are operated at much higher rate of throughput than the rated capacity. The two units are equipped with large Dow surge pumps, in addition to the regular pumping equipment peculiar to this process, and the steam consumption for the cracking department is at the average rate of 4000 pounds per hour. Unless this steam is re-used for other process work, it is dissipated into the atmosphere as it leaves the exhaust side of the pumps. The operators at this plant decided that the wasteful practice was unnecessary and that low pressure steam such as is needed for distillation and redistillation work, some heating, and steaming of filters, should be derived from the exhaust of the cracking unit pumps.

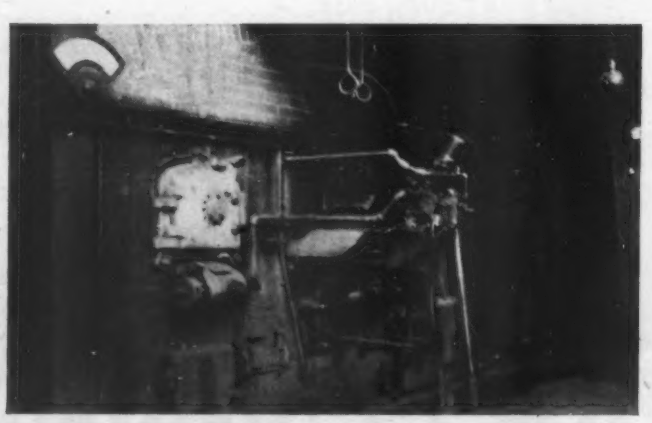
NEW POWER UNIT

With the installation of the cracking department it became necessary to install additional boiler capacity in the power house. The new boiler is a 410 horsepower Oil City water tube boiler which is operated at 150 pounds steam pressure. Four horizontal return tubular boilers are still employed for supplemental or auxiliary work, operating at 80 pounds steam pressure.

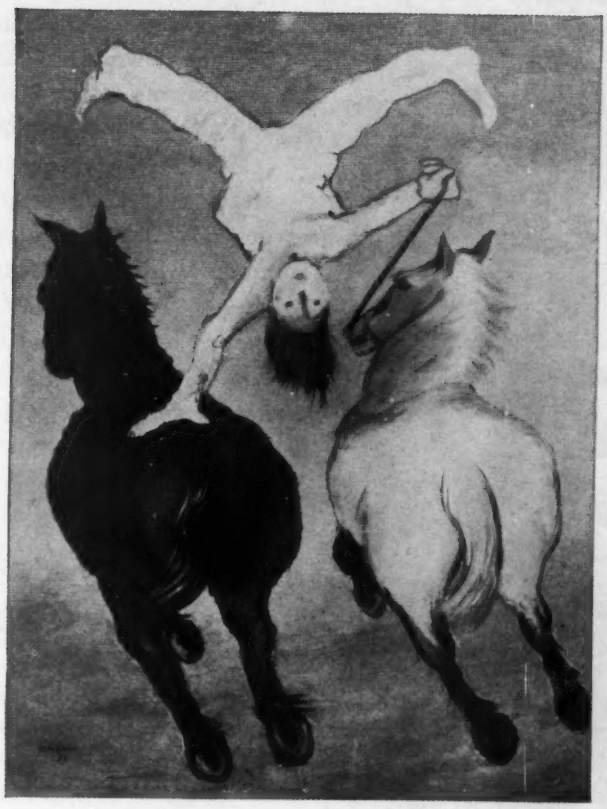
The large water tube boiler is fired with small coal by a type E heavy duty stoker, automatic in its operation. The boiler is set relatively high, as the tubes are 18 to 20 feet above the grates. This provides more combustion space and permits the use of less excess air. With the high setting and mechanical automatic firing the power unit has given eminently satisfactory service, and evaporates 10 pounds of water per pound of coal. It has been operated at 200 per cent above rated capacity. The boiler is provided with all modern control instruments. A General Electric steam flow meter indicates horsepower and records total pounds steam and pounds of steam per hour. A Bailey stem flow meter is provided, and feed water regulator equipment of the same type is employed which controls the discharge side of the feed water pump. A Tagliabue pressure controller is used. There is a forced draft fan in the rear of the furnace flue duct and a wind box pressure guage shows fan pressure. Uptake draft gases are provided. With the aid of these and several other instruments the power unit requires nothing but supervision in its operation. The older boilers are coal fired by hand when in service.

DISTRIBUTING SYSTEMS

Steam for operation of the pumps at the Dubbs cracking units is taken off the steam header on the new water tube boiler, regulated, and conducted to the pumps at about 100 pounds pressure. Passing through the



Automatic stoker coal firing new 410 horsepower water tube boiler at Pennzoil Company's No. 2 plant at Oil Ctiy



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Universal Oil Products Co
Chicago, Illinois

Dubbs Cracking Process
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pumps there is a 70-pound pressure drop, with the pumps operating at 30 pounds back pressure. The 30-pound steam is conducted away from the pumps and back to the refinery for use where low pressure steam is required.

The battery of hand-fired horizontal return tubular boilers discharge steam into a header line at 80 pounds

Arrangement of steam lines and regulator from bleeding off high pressure steam into low pressure distributing system when necessary

pressure. This 80-pound steam is used at various departments about the refinery for pump operation in transferring, loading, charging stills and so forth. Back of the boiler houses the 80-pound steam header is tied into the 150-pound steam header, at which point a Fisher regulator is provided.

With this tie-up the refinery may be provided with 80-pound steam from the big boiler in the event there is not sufficient steam at this pressure derived from the four hand-fired boilers.

In addition the 80-pound steam line is connected to the 30-pound steam line running from the cracking unit pumps to the low pressure steam distributing system. A second Fisher regulator is provided on the connecting line from the 80-pound system to the 30-pound line. In this manner the refinery is provided with low pressure steam from either the four boilers generating steam at 80 pounds, or the water tube boiler operating at 150 pounds, or from both, as needed. This takes care of both systems when the Dubbs units may be shut down for cleaning or repairs. It assures all departments of the plant of a constant supply of steam and either 80 or 30 pounds pressure.

Further, in the event of temporary failure of either steam generating department of the boiler plant, all departments of refinery or cracking plant may be operated without interruption until such repairs as are necessary may be made. The hook-up is simple and although it may appear that there need be a double system of steam distribution throughout the plant, such is not the case, as steam lines are already provided to every department of the refinery regardless of what pressure or temperature steam is employed in teh various process steps. All that was necessary was the installation of a low pressure steam line to gather the exhaust steam from the cracking units pumps and conduct it back to the refinery yard. Naturally some departments require both low pressure and high pressure steam, but in such cases the steam lines are of small size and duplicate lines for the low pressure steam involve no great outlay of expense.

As the system stands, the new boiler provides steam for the Dubbs operation at 100 pounds at the pumps. A block valve and steam regulator in the line back of the boiler provided means for bleeding off some of this high pressure steam when and if need into the 80-pound distributing system. In a like manner valves and regulators provide means for bleeding off steam from the 80-pound steam header into the 30-pound or low pressure system, at the proper pressure.

BALANCE REQUIRED

Complete utilization of the low pressure steam from the exhaust side of cracking unit pumps depends, of course, upon the size of the refinery and the volume of low pressure steam required in distillation work and the like. At the Pennzoil plant the volume of low pressure steam required for redistillation of certain topping plant fractions, the operation of the topping plant and the reducing of crude through wax distillate and the preparation of cylinder stocks, and other re-running, was not great enough to consume the 4000 pounds of steam per hour which passes through the Dubbs unit pumping system. Other uses were therefore found for this excess of low pressure steam, such as heating buildings, and running a line to the filter house for use in cleaning filters. In fact, wherever low pressure steam would suffice the operators employed this exhaust supply, which effects a reasonable reduction on the amount of steam generated at the power house for complete plant operation, and utilizes the heat formerly wasted before the exhaust steam was so utilized.

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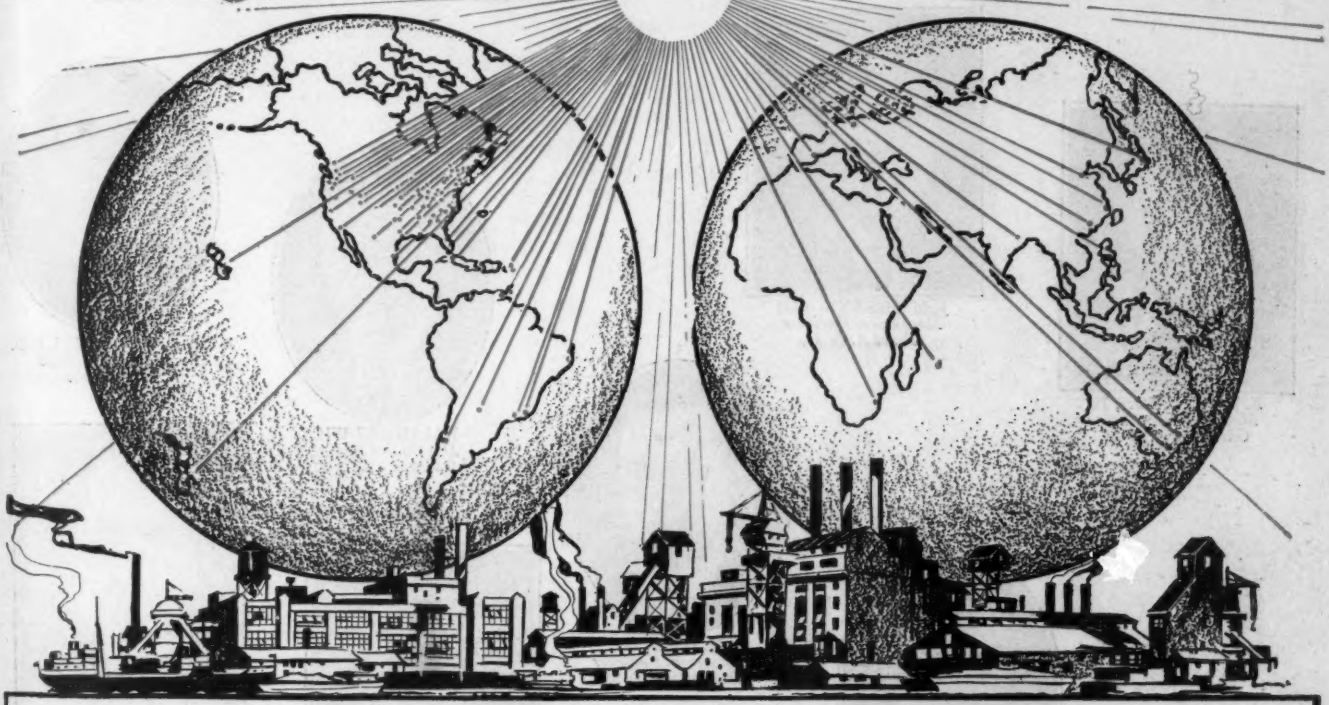

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TANKS REFINING EQUIPMENT

Factors Affecting Operation of Absorption Equipment

(*Continued From Page* 90)

let by means of a lever or an arm. Vent tanks are necessary between the absorber and pump to prevent vapor bind. Automatic flow meters for controlling the flow of oil to the absorber operate a valve by means of a differential drop through an orifice plate. The control valve is either operated by electrical means, using a solenoid, or by a diaphragm valve arrangement such as is used for temperature control. The best practical way seems to be to use the controlling valve in the gas or steam to the pump, thus regulating the flow by speed of the pump. This makes control more sensitive.

The temperature of the entering oil should be maintained uniform, as a varying temperature causes a variation in the degree of absorption, which is in turn reflected by unsteady operation and difficulties of control throughout the plant. Any minor loss of obsorption efficiency for short periods are more than made up by the added efficiencies of the fractionation and recovery systems. A simple means of controlling this temperature is to place a control valve, actuated from the cold oil line near the entrance to the absorber, in a manifold and by-passing arrangement to the hot oil line. In this way a ¾-inch regulating valve will work nicely.

Inasmuch as natural gas consists of a mixture of hydrocarbons of various degrees of volatility and vapor pressure, and in so far as accurate data is available only for two component systems, an approximation based upon the two component system must be used. This is done as suggested by W. K. Lewis, by dividing the system into butane and heavier and lighter than butane. This is done on the basis that butane is the most volatile hydrocarbon that can be permitted in any appreciable quantity in natural gasoline. Therefore for the evaluation and comparison of test data the butane coefficient is used. When equilibrium conditions between saturated oil is obtained, efficiency is unity or 100 per cent. The butane ratio is based on the amount stripped from the original gas by the process of absorption. By the use of Raoults law for vapor pressures of solutions the absorption of other constituents can be estimated for a given operating range of temperature and pressure once the efficiency of butane extraction is known .This ratio is computed for any one temperature by dividing the vapor pressure of butane into the vapor pressure of the constituent to be determined. For hydrocarbons heavier than butane this is greater than one and for lighter less than one, therefore as the efficiency of butane extraction is increased the selectivity for heavier than butane increases at a faster rate than for the lighter constituents, and this is higher at lower oil temperatures or greater oil rate. Absorber efficiencies are comparative only when temperature, pressure, and oil-gas ratio are fixed, or reduced to a standard set of conditions.

Natural Gasoline Association Specifications and Refiners Problems to Be Discussed

A DEPARTURE in the annual program for the convention of the Natural Gasoline Association of America has been provided this year with one day alotted to subjects of particular interest to refiners and blenders. The convention will be held May 20, 21 and 22 in the Mayo Hotel, Tulsa. The second day will be devoted to subjects of interest to refiners and blenders. While programs in the past have had subjects of this nature, this year will mark the first occasion when a whole day of the program has been set apart for the subject.

The convention this year will find the Natural Gasoline Supply Men's Association playing the role of host in matters of entertainment. A dutch lunch each day, a smoker the first evening and the annual dance the second evening will make up the entertainment features, which the supply association will provide. Officials and committees of the organization of equipment manufacturers and dealers have completed all details of the entertainment.

Business matters including the annual report of the president and the appointment of the nominating committee will take up the morning of the first day of the convention program. In the afternoon technical matters will come before the convention. The second day will bring forward the subjects of particular interest to refiners. The third day will consist largely of reports of activities of the association. Dr. George Granger Brown of the department of chemical engineering of the University of Michigan and director of the research program of the association, will make his report on the research program the morning of the third day. Reports of other standing committees will come in the afternoon.

Officials of the Natural Gasoline Association of America are Dr. E. R. Lederer, Texas Pacific Coal & Oil Company, Fort Worth, president; Emby Kaye, Skelly Oil Company, Tulsa; A. J. Schlosser, Barnsdall Oil Corporation, Tulsa, and R. E. Beckley, Standard Gasoline Company, San Francisco, vice presidents, and Ray E. Miller, Tulsa, secretary.

The program committee consists of S. S. Smith, Shell Petroleum Corporation, Tulsa, chairman; Emby Kaye, Skelly Oil Company, and F. E. Rice, vice president of the Phillips Petroleum Company, Bartlesville.

Officials of the Natural Gasoline Supply Men's Association are M. F. Waters, Hanlon-Waters, Inc., president; W. A. Schueter, Refinery Supply Company, and A. J. Kerr, Pittsburgh Equitable Meter Company, vice

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presidents; M. H. Kotzebue, Tulsa Boiler & Machinery Company, treasurer, and Ray E. Miller, secretary.

The directors are J. H. Satterwhite, Westcott & Greis, Inc.; W. G. Cummings, Clark Gas Engine Company; R. H. Howe, Atlas Supply Company; J. D. McMahon Foxboro Meter Company; Dr. E. R. Lederer and Ray E. Miller.

Committees which have had charge of arrangements for the entertainment of the convention are:

Smoker—J. D. McMahon, chairman; J. H. Satterwhite and M. F. Waters.

Dutch Lunches—W. G. Cummings, chairman; D. W. McKay, Hope Engineering Company, and W. A. Schlueter.

Dance—A. J. Kerr, chairman; M. H. Kotzebue and O. Beck, North American Car Corporation.

Badges, Tickets and Favors—W. A. Schlueter and R. E. Howe.

Program Natural Gasoline Association of America

TUESDAY, MAY 20

Registration: 8:30 to 10:30 a. m.

Opening Session: 10:30 a. m.—Frank L. Chase, Lone Star Gas Company, chairman.

Welcoming address: Frank L. Chase.

President's address: Dr. E. R. Lederer, Texas Pacific Coal & Oil Company.

Appointment of Nominating Committee.

NOON

Dutch lunch, furnished by Natural Gasoline Supply Men's Association.

AFTERNOON SESSION: 2:00 P. M.

Specifications: G. M. Davidson, Empire Oil & Refining Company.

Comparison of California and Mid-Continent Problems and Methods: California—H. S. Cole, Jr., The Texas Company; Mid-Continent — A. J. Schlosser, Barnsdall Oil Company.

Discussion.

EVENING

Stag Smoker, furnished by Natural Gasoline Supply Men's Association.

WEDNESDAY, MAY 21

Refiners' Day — The program for this day has been especially arranged to be of interest to refiners and blenders.

MORNING SESSION: 10:00 A. M.

W. A. Melton, Deep Rock Oil Corporation, chairman.

Blending Value of Natural Gasoline: E. W. Zublin, Texas Pacific Coal & Oil Company; S. S. Smith, Shell Petroleum Corporation.

Discussion: R. B. High, Shell Petroleum Corporation.

Natural Gasoline Specifications from the Refiners' Viewpoint: M. H. Nolan, Producers & Refiners Corporation.

Discussion.

NOON

Dutch lunch, furnished by Natural Gasoline Supply Men's Association.

AFTERNOON SESSION: 2:00 P. M.

F. E. Rice, Phillips Petroleum Company, chairman.

Sales Paper: W. K. Warren, Warren Petroleum Company.

Discussion: D. E. Buchanan, Hanlon-Buchanan, Inc.

Outage: Emby Kaye, Skelly Oil Company.

Industrial Relations: Isaiah Hale, Safety Superintendent, Santa Fe System.

EVENING

Annual dance, furnished by Natural Gasoline Supply Men's Association.

THURSDAY, MAY 22

Morning Session: 10:00 a. m.

D. E. Buchanan, Hanlon-Buchanan, Inc., chairman.

Report of Research Program: Dr. George Granger Brown, Department of Chemical Engineering, University of Michigan.

NOON

Dutch lunch, furnished by Natural Gasoline Supply Men's Association.

AFTERNOON SESSION: 2:00 P. M.

Report of Gas Testing Committee: George P. Bunn, Phillips Petroleum Company.

Aviation Fuel: R. C. Alden and Billy Parker, Phillips Petroleum Company.

Discussion: E. C. LeFevre, Empire Oil & Refining Company.

Theory of Absorption: A. Kremser, Standard Oil Company of California.

Discussion: G. G. Oberfell, Phillips Petroleum Company.

Economic Problems Featured At Cleveland Meeting

By GEORGE REID
Associate Editor

THE economics of petroleum production and refining, problems in manufacturing, and co-operation of its membership toward the solution of economic and manufacturing problems were emphasized at the sessions of the National Petroleum Association at its semi-annual meeting in Cleveland, May 23-24. Seven speakers discussed the economic situation within the industry and offered interesting and valuable suggestions as to the course which should be followed to assure profitable operations. Five spoke interestingly along the general lines of co-operation and team work and compared results in other industries secured through collective activities with that accomplished in the refining business. Three excellent papers dealing with manufacturing problems and processing were presented, having to do mostly with the preparation of lubricants. At the final session the association confined its interest to a study of the past accomplishments and future possibilities of its fire prevention and safety work, including a first aid contest in which five teams competed.

E. M. Lyons, president of the association and president of the Tiona Refining Company, in his opening address, "The Oil Industry's Path to Progress," reviewed the history of production and manufacturing and indicated those periods of unbalance as errors which the industry should avoid. He stated that last year the industry turned its inventory over but 1½ times, whereas, one major company was able to turn its inventory over 15½ times during the same period. He pointed to parallel conditions existing in the coal and copper industries in relation to controlling production of finished products from each and cited the recent reduction of four cents per pound in the price of copper as a consequence of lack of co-operative effort in the controlling of production. These industries have problems similar to those of the oil industry but due to the fact that there are fewer companies and individuals involved their problems are or should be simpler of solution. With over 6000 producers of petroleum the task of oil men is enlarged due to the greater number and the widespread activity throughout all sections of the country. He stated that the industry is indeed indebted to those many agencies, including the members of the industry, who are responsible for the success of curtailment of production and the conservation of petroleum. The industry's path to progress leads to stopping over-production and it must balance production and demand and conserve a great natural resource.

O. P. KEENEY SPEAKS

O. P. Keeney, Keeney Oil Company, trustee in charge of the Department of Insurance and also trustee in charge of the Department of Standards and Tests, outlined the progress of his department of standards during the past 10 years and explained how its work is done. There are seven groups of plant technologists in the eastern refining district, involving the association membership of between 50 and 55 companies, who meet periodically to exchange views, experiences and results of the application of testing methods and the work of this group has been of much value to the industry as a whole, in that it has resulted in the adoption of several standard tests methods throughout this country. Mr. Keeney announced that on June 6 and 7 the association will make its annual trip to the Bureau of Mines and all chemists and technologists are urged to attend. The visit this year will differ from past years, in that several papers and discussions will be presented, having to do with such important subjects as specifications of gasoline, anti-knock values of motor fuels, suitable gum tests, sulphur content of gasolines, lubricants and lubricating oil stability.

Under the title of "Advantages that Come from Co-operation in the Motor Industry," Alfred Reeves, general manager, National Automobile Chamber of Commerce, outlined the activities of his association and indicated positively the remarkable results gained by co-operative efforts in manufacturing, and stated that the refining industry should apply such experiences to its business. One outstanding achievement of his association is the cross licensing agreement whereby 1500 patents are thrown into a pool, and which has been recently renewed for five years, and through which agreement there has been 15 years of progress without a single law suit based on patents.

Production figures and export figures are exchanged monthly, including countries and states to which cars are shipped. Sales of used cars are reported, as well

as trucks production and shipments, all of which tends to give a complete picture of the status of the industry. Standardization of 125 parts of cars has been accomplished, as well as 11 sizes of tires through the efforts of this association. As a result of a co-operative survey some years ago, closed car production has increased from 25 per cent to 85 per cent of all cars assembled and shipped. Mr. Reeves detailed a great number of other co-operative activities of his association. In regard to color of automobiles, he stated that they were nearly as rampant as the oil industry, where one could purchase any color of gasoline from any color of pump.

TRAFFIC DEPARTMENT

The first session closed with a talk by Willis Crane, traffic attorney for the association, who reviewed his five years work in developing the traffic department, and cited results of several important cases where member companies and the whole industry had been benefited. He stated that the success of such a co-operative venture was dependent upon three vital factors, namely, a sound policy, sound co-operation, and the building of a good name.

N. H. Weber, Pure Oil Company, and trustee in charge of the Department of Trade and Commerce, at the afternoon session reported on the purpose and activities of his division, emphasizing the importance of interchange of vital statistics and their application to the business.

Through the efforts of the Washington office, a complete study of the production and consumption of Pennsylvania grade crude oil was made for the first time last year. Acting upon the belief that the facts should be reported currently and made available by a public agency, the general counsel of the association then arranged with the Bureau of Mines to change its schedule of production so as to separate Pennsylvania grade crude from non-Pennsylvania grade in the Appalachian field and to report separately stocks of this grade by location at refineries. The result was that starting with January of this year the Bureau of Mines reports show production, domestic demand (that is crude run to stills, less losses in handling), stocks in pipe lines and tank farms, and at refineries, of Pennsylvania grade crude oil. These reports will be continued monthly in the future. In addition to that, through the courtesy of the South Penn Oil Company, the Washington office of the association is reporting each month to the 44 refining companies processing this grade of oil the stocks of the South Penn Company plus the producers' unsold credit balances. There is now available, therefore, complete information regarding the supply and demand of this grade of oil. These statistics should be of interest and value to other refining companies in other districts.

INTEGRATED COMPANIES PROGRESS

A. M. Maxwell, vice president, Standard Oil Company of Ohio, addressed the convention on the subject of "The Manufacturers' Relations to the Marketers' Problems." He pointed to the progress toward the integrated type of company controlling its own retail outlets, and stated that manufacturing became thoroughly speculative when production is not in line with visible buyers' requisitions, and advised that each organization study the current economics of the industry and its marketing territory. Modern equipment is easily able to yield products to meet current demand month by month or even week by week, and this should make it possible to eliminate carrying excessive stocks at refineries and the adjustment of production at the refineries to meet known needs is the solution to the present situation. He stated further that progressive and successful marketing was dependent upon quality advertising, quality products, and quality personnel to push them.

C. F. Kettering, president, General Motors Research Corporation, addressed the convention in his usual interesting and instructive manner. He stated that the automotive industry was founded on three things, rubber, alloy steel and petroleum. In relation to the progress which these industries have made he stated that the rubber people had progressed 55 to 60 per cent of the distance they estimated was possible for them to go in perfecting their products; that the steel industry had made 40 to 50 per cent of what progress it should, and that the petroleum industry had gone but 30 to 40 per cent of the way. However, he added that in distribution of products the petroleum industry had progressed about 110 per cent or more, and that he estimated that such activity had not yet gone as far as it would later.

FUEL LIMITS MOTOR

Mr. Kettering stated that the limiting factor of the internal combustion motor is fuel alone, and that the limiting factor of fuel lay in the term or factor—detonation. Detonation is an all important factor, for it limits the use of the internal combustion engine. Once this difficulty is eliminated there is no reason why the internal combustion engine will not become the source of power under any condition where power is needed. He discussed the coming of long distance express highways and the accompanying increase in motor car hours and its direct bearing upon motor fuel and lubricants consumption. He expects much greater development in the next 25 years than has been experienced in the past 25 years, especially in the extended use of the internal combustion engine for power for every purpose.

President E. B. Reeser, of the American Petroleum Institute, spoke on the subject, "Efficiency and When Does It Cease to Be Efficient." He pointed to the past conditions of feast or famine, and complimented the industry in its endeavor to replace selfishness with co-operation and thus avoid the periods of famine. He stated that the Pennsylvania producing district was not

ONE SMITH ORDER SELLS THE NEXT

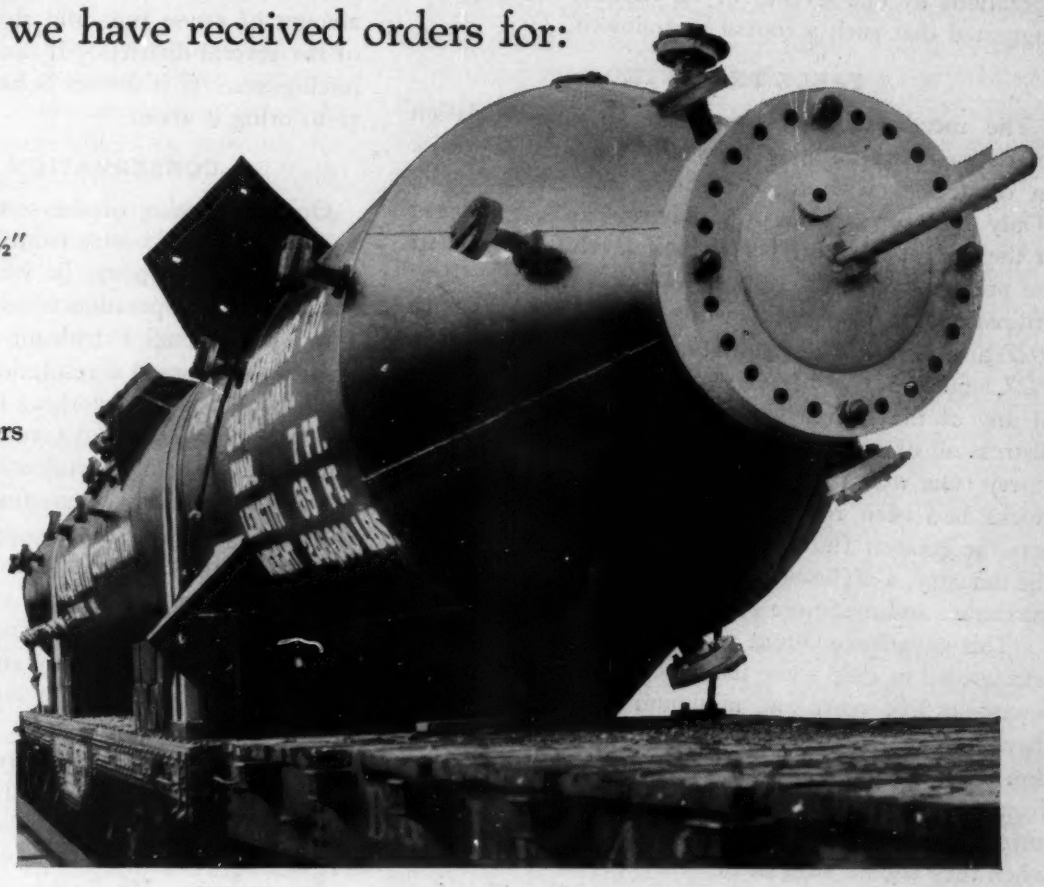
On October 9, 1928, the A. O. Smith Corporation received their first order from one refining company for 4 Fractionating Columns, 7′ I. D. x 69′2⅛″ x 3½″ wall.

Since then we have received orders for:

March 8, 1929
4 Collecting Chambers
21″ I. D. x **26′ 3″** x **1½″** wall.

April 12, 1929
10 Separating Chambers
7′ I. D. x **28′** x **3½″** wall.
10 Fractionating Towers
7′ I. D. x **30′** x **3½″** wall.

October 29, 1929
8 Separating Towers
9′ I. D. x **30′** x **1¾″** wall.
8 Fractionating Towers
9′ I. D. x **33′** x **1¾″** wall.
8 Receiving Drums
6′ I. D. x **16′** x **¾″** wall.
8 Receiving Drums
6′ I. D. x **16′** x **1″** wall.



The second order in units equalled the first.
The third order in units was five times the first.
The fourth order in units was eight times the first.

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SMITH*WELDED* CRACKING STILLS

co-operating with the other districts in their curtailment efforts and pointed to the Bradford area, where flooding work is effecting an increase in production of crude. This excellent grade of crude sells for less than it is worth and Pennsylvania crude is the only grade which has not been raised in price in recent weeks. Continued increasing production in these districts, he indicated, is a disregard for essential values. In regard to the refining industry he stated that this branch should not and could not expect to operate at capacity at its present high efficiency. He complimented this branch of the industry because of its attempts to cut operations by one-seventh of its capacity since it was suggested that such a course be followed.

TABLE PRESENTED

The membership was provided with a tabulation which gave the gasoline story for the past 12 years. In connection with these statistics Mr. Reeser said, "Only in three years out of 12 have stocks been reduced at the end of the year below their level at the end of the previous year. In 1918, a war year with its extraordinary demands, stocks were reduced,and again in 1927 and 1928. The maximum quantity of stocks in 1927, or 52,532,000 barrels was the greatest maximum of any of the 12 years. This fact brought about the distress all of us remember, which distress reduced refinery runs with the result that at the end of the year stocks had been reduced by 5,507,000 barrels. This was the greatest fluctuation of stocks in the history of the industry, a difference of 22,270,000 barrels between maximum and minimum supply.

"This experience taught our enterprise a lesson which was heeded in 1928 when the maximum stocks were the lowest in five years and minimum stocks were lower than in any of the three preceding years. This transition from 1927 to 1928 for the refiner was a transition from acute losses to a fair degree of prosperity. But unfortunately better conditions stimulated manufacture when they should suggest moderation.

"This was clearly evidenced in 1929. The better conditions of 1928 carried into the first half of 1929, but before the year was over the stimulation to increased manufacture had its apparently predestined effect. So, as a third observation you will notice the increase in stocks in 1929—over 10,000,000 barrels—was greater than in any other year of the 12-year period.

"The effect of persistent over-production upon prices over the 12-year period is clearly shown, and after study is finished the conclusion you will surely reach is that the industry has not mastered the principle of balance. Its refinery operations have swung like a pendulum from one extreme to another.

"The oil industry now has two reasonably prompt and accurate statistical services. It knows each week the amount of crude runs and stocks of gasoline for each of the several districts. It can guide its operation with intelligence. If it desires balance it lies within its power to bring it about."

CONSERVATION ENDORSED

On the morning of the second day, and subsequent to the reading of a wire from Henry L. Doherty, Cities Service Oil Company, in which he outlined his advocacy of unit operation which was started by him before the National Petroleum Association in 1923, the association adopted a resolution endorsing the work of the several agencies working in behalf of conservation of crude petroleum and natural gas.

P. S. Tarbox, Independent Refining Company, trustee in charge of the Department of Manufacture, addressed the session on "Co-operation in Solving Manufacturing Problems." He stated that competitors can eat together without eating each other, and that in the Appalachian refining district from 5 to 50 men in each group eat together monthly and discuss their problems. Such discussions center on such matters as distillation, fuel economy, filtering—and filtering costs have been reduced 50 per cent in many instances as the result. Fuel reduction has amounted to 78 pounds of coal in four years as the result of the co-operative work done by 15 refineries under the direction of Herbert A. Ross.

In conclusion, Mr. Tarbox said:

"Not many months ago, a representative of one of our trade journals made an inspection of the old Penn-

STATISTICS OF FIN

(BARRELS OF

	STOCKS OF GASOLINE					YEAR'S PER			
Year	Max.	Min.	Fluctuation in Stocks	Stocks Dec. 31st	Inc. or Dec. over Previous Year	Number of Day's Supply Max.	Min.	Total Supply	Per Cent Yearly Inc.
1918	12,532,000	5,960,000	6,572,000	7,079,000	— 2,736,000			89,589,000	25.97
1919	14,143,000	8,432,000	5,711,000	10,637,000	+ 3,558,000	56	32	99,850,000	11.45
1920	15,332,000	6,861,000	8,471,000	11,009,000	+ 371,000	54	21	123,221,000	23.41
1921	19,059,000	10,863,000	8,196,000	13,954,000	+ 2,945,000	55	31	132,364,000	1.42
1922	21,244,000	16,429,000	4,815,000	21,042,000	+ 7,088,000	58	40	165,489,000	25.03
1923	33,665,000	25,320,000	8,345,000	28,014,000	+ 5,137,000	71	48	203,971,000	23.25
1924	41,821,000	29,607,000	12,214,000	30,820,000	+ 2,806,000	74	48	231,947,000	13.72
1925	41,512,000	35,572,000	5,940,000	38,875,000	+ 8,054,000	63	50	276,778,000	19.33
1926	46,121,000	33,257,000	12,864,000	39,023,000	+ 148,000	60	40	312,522,000	12.91
1927	52,532,000	30,258,000	22,274,000	33,316,000	— 5,707,000	60	32	344,599,000	10.26
1928	41,195,000	26,378,000	14,817,000	33,066,000	— 250,000	42	25	391,055,000	13.17
1929	48,205,000	33,222,000	14,983,000	43,115,000	+10,049,000	44	29	452,930,000	16.14

sylvania field, and here are some extracts from his observations: * * *

" 'Operation of development shrouded in mystery fosters suspicion and dishonorable practices. Discreditable and deceitful bartering of trade information, covert and surreptitious exchange of data, and clandestine and underhand swapping of knowledge, is certain to follow. Formulas held in the secret files of one company are practically always present in the files of competitive organizations. This material is not pilfered, filched or stolen. It is simply disseminated inadvertently, satisfying the curiosity of conferees interested in similar subjects. Sketches of secretly fabricated processes in one district soon come to light in all other districts.

" 'One group of Eastern refiners in working together 28 years has found through their association with one another that even process costs may be brought to light and in open discussion means are often provided for their reduction. Lasting friendships, distrust supplanted by confidence, better efficiency of plant operation, standardization of tests and specifications, accurate knowledge of stocks of all products, and general conditions within the membership are among the advantages accruing from their work together.

" 'The processing secret, or the secret processing, went into the discard years ago. These operators have found that the short-cut, the item of economy, the formula of special products, the special equipment of processing at one plant, is always an 'open secret' firstly, and secondly, that these things are usually inapplicable at another plant without modification. There is no corner on alertness.

" 'It might well be said that these refineries have strikingly indicated that 50 heads are 50 times better than one head in most cases. The leader in the application of new process shares his experience with his neighbors. If the process is unworthy it is discarded. If it is economical and efficient it is adopted by the industry, improved upon, and those improvements are thrown back to the original investigator for his benefit. No one has suffered. Where the district was but a few years back somewhat inefficient in operation as a refining district, it is now, as a district, one of the most efficient in the industry. So all have profited.

" 'That group of refiners comprising the membership of the National Petroleum Association has done more to expose the fallacy of secrecy in manufacture than any other group. Nor have they been exclusive, for their plants, chemical, and engineering departments have been open to visitors from other districts for years.' "

The paper on "Factors Governing the Crystallization of Wax in Paraffin Distillate," by H. J. Dunmire, Valvoline Oil Company, was distributed to those members present for future study.

H. S. Bell, refinery engineer, entertained the meeting with a talk of his experiences in Russia, and three reels of motion pictures which he took in that country. Interesting views of the 140,000-barrel capacity refinery at Baku were shown, including detail views of the various departments of this large refinery. Much of the equipment is foreign, but as much more is American. Field views of the various oil producing areas followed. The new work is all rotary drilling with about half of the equipment being American. Electricity is widely used for power, and much oil is produced by air and gas lift methods. Strangely, lubricating oils are made from asphalt base oils and the Russians are burning the paraffin base oils as fuel, which is probably accounted for by the ease of preparation of lubes from the asphalt base crudes. Cracking stills operate both on mazout (fueloil) and mixtures of fuel oil and gas oil. A great deal of new construction work is in progress, Mr. Bell said.

D. G. BRANDT'S PAPER

"Modern Trends in the Manufacture of Motor Lubricants," was the title of a very interesting and valuable paper by D. G. Brandt, Henry L. Doherty & Company. Mr. Brandt's paper is presented elsewhere in this issue. It includes some interesting discussion of the possibilities of newer methods of lubricating oil preparation and wax removal, especially those views on solvent extraction. Commander G. C. Davidson, president of the Tri-State Refining Company and trustee in

[1]Refiner & Natural Gasoline Manufacturer.

ISHED GASOLINE

42 GALLONS)

CENT INCREASE		Per Cent. of Stocks to Total Demand		Group 3 Prices Cents per Gallon			Gulf Cargo Prices Cents per Gallon			Oklahoma 36° Gravity Crude Price			Year
Total Demand	Per Cent Yearly Inc.	Max.	Min.	Max.	Min.	Average	Max.	Min.	Average	Max.	Min.	Average	
92,326,000	32.78	13.57	6.46										1918
96,291,000	4.30	14.69	8.76	18.75	15.75	17.42	22	17	19.5	$2.75	$2.25	$2.30	1919
122,850,000	27.58	12.48	5.58	23.75	16.00	21.52	22¼	17	21.3	3.50	2.75	3.43	1920
129,419,000	5.35	14.73	8.39	21.00	11.00	14.37	21¼	16	18.1	3.00	1.00	1.63	1921
158,401,000	22.39	13.41	10.37	18.88	10.59	14.47	19½	15	17.4	2.00	1.25	1.68	1922
198,883,000	25.53	16.93	12.73	14.12	6.34	10.10	16	10	13.3	2.00	1.00	1.56	1923
229,141,000	15.24	18.25	12.92	11.36	6.97	9.16	14	10	12.5	2.00	1.00	1.64	1924
268,724,000	17.27	15.45	13.24	12.93	8.50	10.64	14	10	11.9	2.04	1.25	1.87	1925
312,374,000	16.24	14.76	10.65	11.75	9.20	10.45	12¾	10	11.3	2.29	1.79	2.13	1926
350,306,000	12.14	15.00	8.64	9.10	6.10	6.85	11	7	8.0	1.90	1.28	1.38	1927
391,305,000	11.40	10.53	6.74	9.73	5.93	7.97	10	6¾	8.7	1.36	1.28	1.31	1928
442,881,000	13.49	10.88	7.50	9.22	6.93	7.72	8½	7¾	8.0	1.45	1.20	1.37	1929

charge of the Division of Scientific Research, called attention to the importance of the application of data available through the science of thermodynamics. An interesting and instructive discussion of the economics of gasoline was presented by Warren Pratt, National Petroleum News.

R. A. Wotowitch, Henry L. Doherty & Company and trustee in charge of the Department of Fire Prevention and Safety, presided over the final session of the convention. This session was given over to the Fire Marshal's Association. Mr. Wotowitch and James Herbert, Standard Oil Company of Ohio, spoke on the subject of "What the Department of Fire Prevention is Promoting." Houston Dunn, secretary of the National Petroleum Mutual Fire Insurance Company, addressed the meeting and stated that the fire marshals' association was the most important move of the Eastern refinery group to date. He reported his efforts at Shreveport in March to interest the membership of the Western Petroleum Refiners Association regarding the formation of a similar association in the Mid-Continent area, and stated that at their request all available data and information had been furnished them.

The association this year presented a bronze plaque to the winning first aid team participating in the first aid contest. Medals for each member of the winning team were given through the courtesy of E. M. Lyons, president of the association. The first aid contest was won by the team from the Conewango Refining Company. Kendall Refining Company's team was second, and the teams from Standard Oil Company of Ohio's plants won third and fourth place. Independent Refining Company's team was fifth. It was planned to hold another first aid contest in Pittsburgh at the next annual meeting of the Fire Marshal's Association of the National Petroleum Association in January, 1931.

Modern Trend in Manufacture Of Motor Lubricants

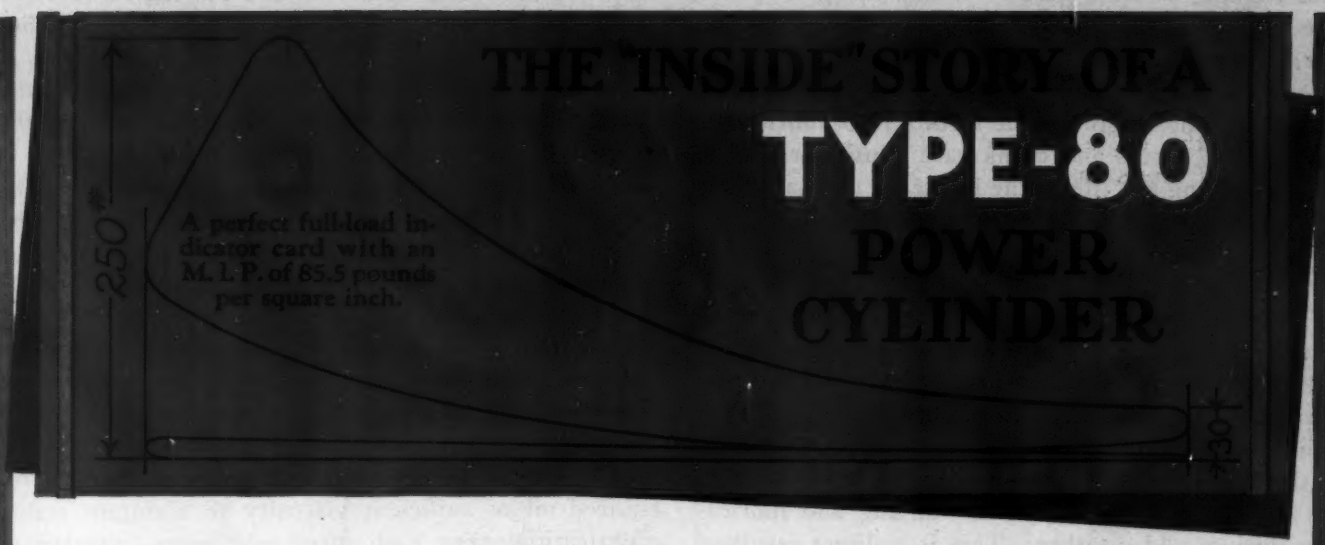
By D. G. BRANDT
of Henry L. Doherty & Company

Before National Petroleum Association, April 23-24, Cleveland

BEFORE discussing the modern trends in the manufacture of motor lubricants, it is perhaps advisable to first review the changes in automobile engine design that are responsible for the present trend. The competition of various automobile manufacturers and the development of better roads has resulted in the production of a machine of high mechanical dependability having a driving speed range from five to 90 miles per hour in high gear. Traffic conditions and the increased number of machines in operation have made the rate of acceleration one of the major factors in design.

In order to meet these conditions, the maximum developed horsepower required has been ever on the increase. This increase in horsepower has been accomplished by increasing the piston displacement, speed and compression ratio of the engine. A comparison of a group of cars of five years ago with corresponding cars of today illustrates how decided this change has been. The cars compared were of the same make, type, and had the same number of cylinders. In the case of piston displacement, an increase of seven per cent was found and there was a corresponding increase in the compression ratio of 12.2 per cent. The average figures for the compression ratios were 4.46 to 1 and 5.0 to 1, showing an increase of 0.54 over the five-year period. The increase in speed is marked, as the average R. P. M. at maximum developed horsepower five years ago was 2443, whereas today it is 3014, which is an increase of 23.4 per cent. In the case of maximum developed horsepower, the increase has been remarkable, showing a gain of 52 per cent, or from 52 to 79 horsepower over the five years.

As mentioned above, the figures quoted are not the figures of the over-all increase in the factors mentioned, but represent only a selected number of representative cars on which a direct comparison could be made. As the maximum developed horsepower increases, the operating range also increases inasmuch as the minimum power requirement remains fixed. We have lengthened the driving range, but the average driving speed has not increased proportionately because of the increase in traffic. However, on the open road the average driving speed has increased from approximately 35 to 50 miles per hour. Thus we actually have two average conditions that are widely different, that is, the car must function properly at a comparatively low driving speed, with quick acceleration in traffic and at high driving speed under open road conditions. This wide variation of operating conditions has introduced new complications in the lubricating problem and because



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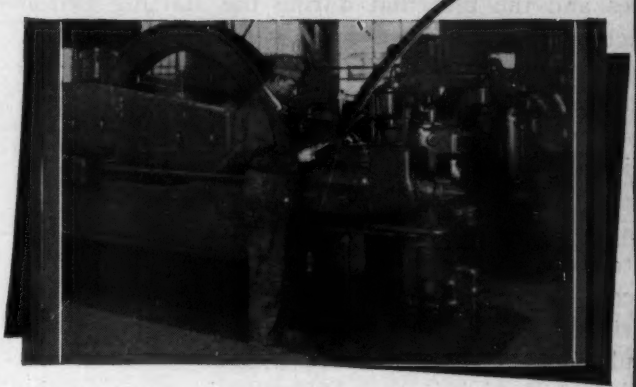
As told by the Indicator Card



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this change has been gradual over a period of years, the production of a lubricating oil for the service has been a continuous research problem. The automobile manufacturer has assisted in this problem by equipping the engine with forced feed lubricating systems, oil filters and crank case ventilators, all of which prolong the life of the lubricant used and help to maintain the original viscosity of the oil.

VISCOSITY INCREASES

There has been a constant increase in the viscosity of the lubricant used in the automobile engine as the speed and compression ratios increased. The viscosity of the lubricants have now increased to a point where we are experiencing carbon formation in the cylinders and valves due to the breakdown of the heavy oil and difficulty in starting and lubrication during cold weather. This is a direct result of the low fluidity and tendency toward plasticity of the heavier lubricants at frigid temperatures. The production of low cold test oils is helping to improve the situation but much difficulty is still encountered because of the high shear stresses at low temperatures and the fact that during the starting period practically no lubricant reaches the cylinder walls. This is due entirely to the fact that even though the pour point of the lubricant is low its plasticity at the lower temperature is high and the splash system of delivering lubricant to the cylinder walls is not effective as long as the temperature of the lubricant remains low. This causes undue wear on both the piston and cylinder walls during the starting period in cold weather if the lubricant is cold at the time of starting. The cranking effort necessary under these conditions is high and increases rapidly with the viscosity of the lubricant. Difficulty in pumping the lubricant is encountered for the same reasons and it is found that the lubricant must reach its pour point temperature before pumping will be satisfactory. For this reason the pour point of lubricants has given major consideration and it has been found possible to produce oils from almost any type of crude oil of substantially zero pour point. Although these oils are now being produced commercially they have failed to materially reduce the starting difficulties, due to the plasticity of the lubricant at low temperatures.

THREE FUNCTIONS OF LUBRICANT

Fundamentally, the lubricating oil in an engine performs three major functions, first, lubricating the moving parts; second, sealing the pistons; and, third, cooling. First, from the standpoint of lubrication of moving parts, it may be pointed out that in the development of other high speed machinery the trend has been toward a lubricant of lower viscosity. If the coefficient of friction were plotted against a modulus $\frac{ZN}{P}$, in which Z is the relative viscosity of the fluid, N is the speed of the bearing surface, and P is the normal pressure on the bearing surface per unit area, it would be noted that as $\frac{ZN}{P}$ approaches zero the coefficient of friction increases rapidly, and, also, that as the value of $\frac{ZN}{P}$ becomes greater, the coefficient of friction increases very slowly. The zone of unstable lubrication is that portion of the curve where the film of lubricant is broken and the value of the modulus $\frac{ZN}{P}$ approaches zero. Stable lubrication is represented by the right hand portion of the curve where the coefficient of friction rises slowly with a corresponding increase in value of $\frac{ZN}{P}$.

Thus for a given speed and pressure there is required oil of sufficient viscosity to maintain stable lubrication. For high speed machinery operated at constant speeds, the selection of a proper lubricant is relatively simple, but in the case of the present day automobile engine operated at a wide range of speeds, the selection is not so easy. The selection, however, should be made so that at slow speeds lubrication will be stable and the coefficient of friction low. This would necessarily make the coefficient of friction greater at high speeds, but in order to secure stable lubrication at all speeds some efficiency must necessarily be sacrificed. From this reasoning it is evident that the proper oil for lubricating purposes does not need to be extremely viscous and that the heavy oils now being used were selected for other reasons.

PISTON SEAL IMPORTANT

Considering the changes that have resulted in the present day automobile, it must be borne in mind that difficulty in securing a satisfactory piston seal would be a direct result of the greater operating range of the machines and the higher compression ratios. It has already been mentioned that, although the approximate driving speed on the open road has risen as high as 50 miles per hour, the usual driving speed because of traffic conditions is not materially higher than it has been in the past and the percentage of idling time has increased. Confronted with this condition we find that when operating at low speeds a decided vacuum is created in the cylinders on the intake stroke and that some of the lubricant is drawn into the cylinder, although the seal is not broken. Likewise when operating at high speeds, difficulty is also encountered in the loss of lubricant. However, in this case the difficulty results from the higher temperature of the cylinder walls and the reduced viscosity of the lubricating oil film forming the piston seal. At the higher speeds the piston ring does not wipe the wall entirely clean on the down stroke and on the compression stroke this oil is carried into the combustion space by the piston. In the case of the older engines the normal operating speed was closer to the maximum operating speed

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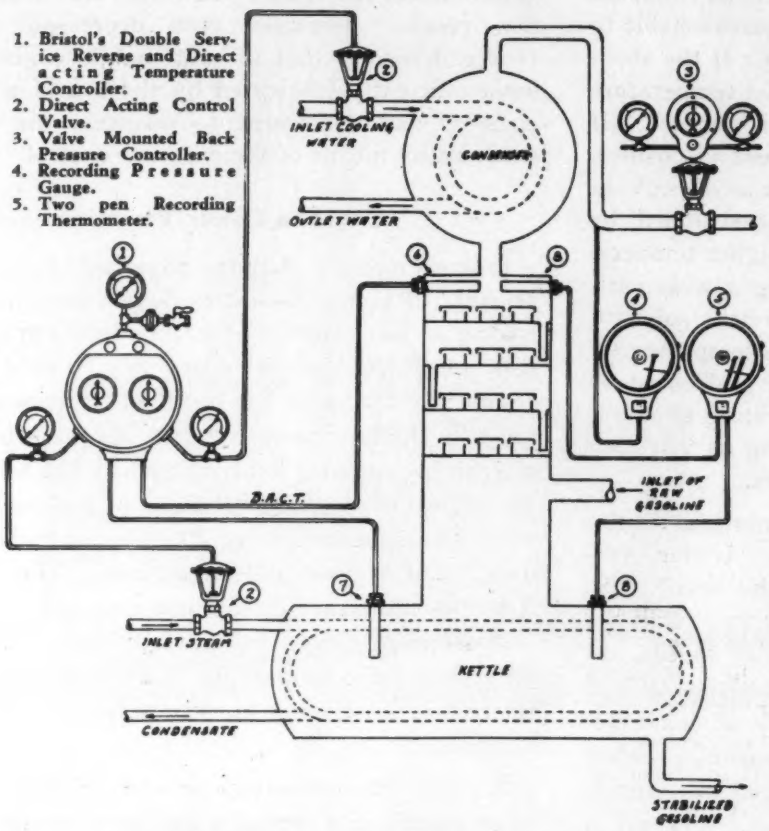

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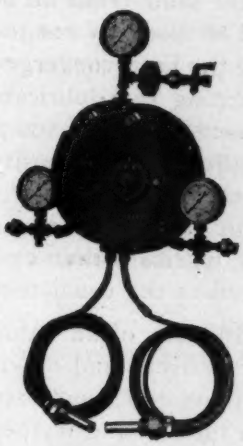

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and the difference in cylinder and crank case pressures was not so pronounced. Likewise, inasmuch as operating speeds were lower, temperatures were not so high and the securing of an effective piston seal, even with the less viscous oils, was not difficult. The rapid loss of viscosity with temperature should receive considerable attention, for although there is very little information available as to piston working barrel temperature, it is not unreasonable to assume that they are as high as 430°F. If the absolute viscosity of an oil is plotted against temperature on logarithmic paper a straight line is secured. If the lines of three lubricants of different viscosities, but from the same crude oil base, such as of S. A. E. 30, 40 and 50 viscosity ranges are plotted, it will be found that the lines converge at the higher temperatures indicating that lubricants having a wide variation in viscosity at test temperatures have substantially no difference in viscosity at high temperatures. Thus, I believe that a more effective seal could be produced by the reduction of the operating temperature of the lubricant than by increasing its viscosity as measured at the usual temperatures.

The third duty of an automobile lubricant is the cooling of bearings and moving parts. Under present conditions the temperature of the crank case rises from the starting temperature to an average of from 130°F. to 150°F. Increased engine speeds and bearing pressures have made the splash system of lubrication inadequate and practically all manufacturers have adopted forced feed lubrication, or what might be more correctly termed forced oil circulation, to supplement the splash system. The oil is pumped from the crank case through the bearings back to the oil pan where the only means of cooling is by radiation. If the oil pan were insulated and a cooler installed in the oil pump discharge line, more adequate cooling could be provided which would compensate for the wide range of climatic conditions and driving speeds.

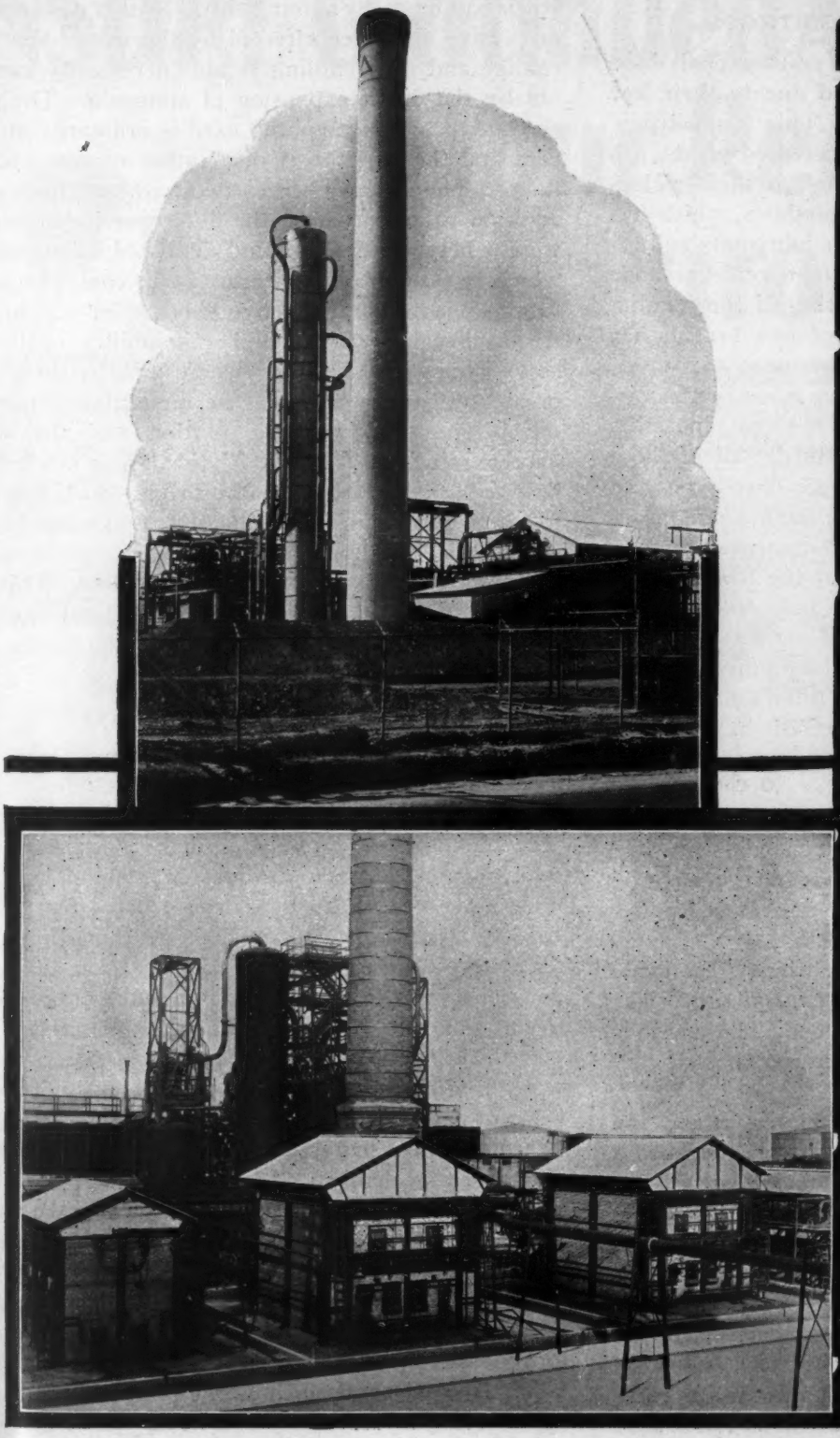
As previously mentioned, the automobile manufacturer has endeavored to extend the life of the lubricant and maintain the original viscosity, but very little attention has been given to temperature control of the lubricant necessary to maintain a constant viscosity under operating conditions. This could be accomplished by an independent controlled cooling system with several resulting advantages. First, by supplying precooled oil to the bearings for cooling, the quantity of oil circulated could be reduced. Second, it would be possible to use a cooled lubricant of lower viscosity for lubrication and reduce the friction of the moving parts. Third, if a forced supply of a precooled lubricant with constant circulation or replacement was supplied for sealing the pistons, an effective seal could be secured with an oil of relatively low viscosity at test temperatures because of the reduced temperature. From this it is evident that if the proper provisions were made for temperature control of the lubricant, it would be possible to use a less viscous oil than that now in use and at the same time increase the efficiency of lubrication. It is a well known fact that starting and lubricating troubles at low temperatures decrease with decreased viscosities of lubricants. It is also true that the carbon residue decreases with decreased viscosity. Hence, I believe that the automobile engine can be most efficiently lubricated by the use of a less viscous oil and equipment to maintain the viscosity constant by means of temperature control.

Trend to Lower Viscosities

It is my opinion that the trend will be toward lubricants of lower viscosities, lower pour points and having as flat a temperature viscosity curve as possible, but lower viscosities will only be used after the engine manufacturer has installed temperature regulation in the lubricating system. In the manufacture of such high quality lubricating oils, the selection of the proper crude oil is of major importance. Crude oil is classified into three divisions, namely, asphalt base, paraffin base, and mixed base. The last mentioned is a mixture of the first two and its physical and chemical properties will approach either those of asphalt base or paraffin base, depending on the relative percentage of the two substances present in the crude.

An inherent characteristic of lubricants prepared from asphalt base crudes is the low cold test that may be obtained without special processing. However, the slopes of their temperature-viscosity curves are steep and at pour point temperatures they deviate widely from the laws of viscous flow. Their volatility is high, with a low carbon residue, for this reason. On the other hand, we find that without special processing the paraffin base oil solidifies at frigid temperatures because of the precipitation of wax. With special processing, however, it is possible to obtain a product having a cold test equivalent to that of asphalt base oils. The lubricant prepared in this manner follows the laws of viscous flow more closely at pour point temperatures than the asphalt base lubricants, although there is some divergence. The volatility of the paraffin base lubricant is lower and the carbon residue is higher than in the case of lubricants of the same viscosities prepared from asphalt base crudes. A marked characteristic is the relatively flat temperature-viscosity curve of the paraffin base oil.

As pointed out, lubricants made from the two crude oils have some physical and chemical characteristics which cannot be changed by processing, and both research and actual performance have dem-



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Empire Oil & Refining Co.

Texas Pacific Coal & Oil Co.

Associated Oil Co.

Pennzoil Company

Independent Refining Co.

Gulf Refining Co.

Tidal Refining Co.

Continental Oil Co.

Anglo-Mexican Petroleum Co. Ltd.

Cities Service Refining Co.

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onstrated the superiority of those made from the paraffin base crude oils.

IMPROVED REFINING METHODS

However, during the last few years asphalt base lubricants have been widely used due to their low pour test and carbon residue. This competition, coupled with the possibility of increased yields, has awakened the Pennsylvania refiner to the development and use of more scientific methods, which has resulted in increased yields, better lubricants and reduced costs of production. The improvements made have been in practically all branches of the refining industry and the improvement of one branch has assisted and hastened the improvement of others. The major improvement has been made in the distilling equipment by the use of modern pipe stills and fractionating columns. Practically all of these units are of the atmospheric single flash type. In this type of unit all the oil above the bottoms product is vaporized in a body and the vapors are then separated into the various cuts in the fractionating column. With this system, very close fractionation is obtained and it is possible to produce substantially all cuts without rerunning. These units are very flexible and cuts can be varied as to boiling range or viscosity to suit the products desired. The use of such distilling apparatus produces wax distillates and cylinder stock bottoms of better colors, and simplifies the wax removal, as well as increases the yield of viscous oils. Such equipment and also vacuum units built along similar lines have been used for rerunning and reducing pressed wax distillates and bright stock solutions.

The demand for low cold test lubricants has made it necessary to manufacture both neutral and bright stocks of substantially zero cold test. The methods used are special pressing, centrifuging, filter aid methods and solvent extraction.

Neutral oils are being dewaxed in very nearly the same manner as in the past, the only variation being that special or double pressing is being resorted to in order to secure approximately zero cold test products. The process of dewaxing by pressing has been used for a number of years and only the changes that have been made in order to secure wax-free oils will be discussed. The use of direct ammonia expansion for final chilling has been found necessary and progress has been made in determining the chilling rates that give the best crystallization of wax. Economies have been introduced into this method in the form of heat exchange that have aided in keeping the refrigerating requirements at a minimum. Press room temperatures have also been lowered in order to prevent an increase in temperature of the stock being dewaxed and the resulting redissolving of wax that had been precipitated at the lower temperature.

The dewaxing of bright stock-naphtha solutions by centrifuging is substantially the same procedure that has been used during the past few years with the exception that operating temperatures have been reduced as low as —40°F. in order to secure a bright stock having a 5°F. pour point. In this case economies have also been effected by the use of heat exchange and final chilling is also necessarily carried out by the direct expansion of ammonia. The percentage of solvent naphtha used is ordinarily 60 per cent and the naphtha is of a rather narrow boiling range. The naphtha serves two purposes, in that in addition to accentuating the difference in molecular weight between the wax and dissolved bright stock, which is essential in order to obtain complete separation, it acts as a selective solvent for the bright stock. Because of the higher solubility of bright stock in naphtha than of wax in naphtha there is a greater difference between the molecular weight of the bright stock-naphtha solution and the wax-naptha solution. Because of the larger amount of heat to be extracted from the bright stock solution to be centrifuged in the production of wax-free bright stock and the high operating vacuums of the refrigerating system the over-all efficiency is low. This results in increased operating and overhead expense that is in reality out of proportion to the results obtained.

FILTER AIDS AND SOLVENTS

The other two methods referred to were dewaxing by the use of filter aids and solvents. There are mechanical difficulties to be overcome before either process is used extensively and neither is being used to any great extent at the present time. The Weir filter aid process may be used for dewaxing bright stocks and has one advantage over centrifuging in that the process is simpler. The stock in this case must also be diluted with naphtha and from one-half to one pound per gallon of filter aid material is required. It has been found necessary in experimental work to dilute the bright stock with as high as 75 per cent naphtha and maintain a 30°F. differential between the filter temperature and pour point desired. There are mechanical difficulties in operation such as recovery of filter aid naphtha. However the naphtha loss does not greatly exceed the loss in centrifuging. The possibilities of wax extraction by the use of solvents has been appreciated for some time but the high cost of solvents and the possible handling losses has delayed the development of the process. However, inasmuch as the process can be carried out at temperatures considerably above the pour point of the oil desired, I am of the opinion that the mechanical difficulties involved in the development of the process can be readily overcome and wax free oils produced at costs substantially the same as those produced by other processes.

MIXED BASE CRUDES

In discussing the trend of manufacture of lubricating oils the manufacture of lubricants from mixed base crudes cannot be overlooked. The production

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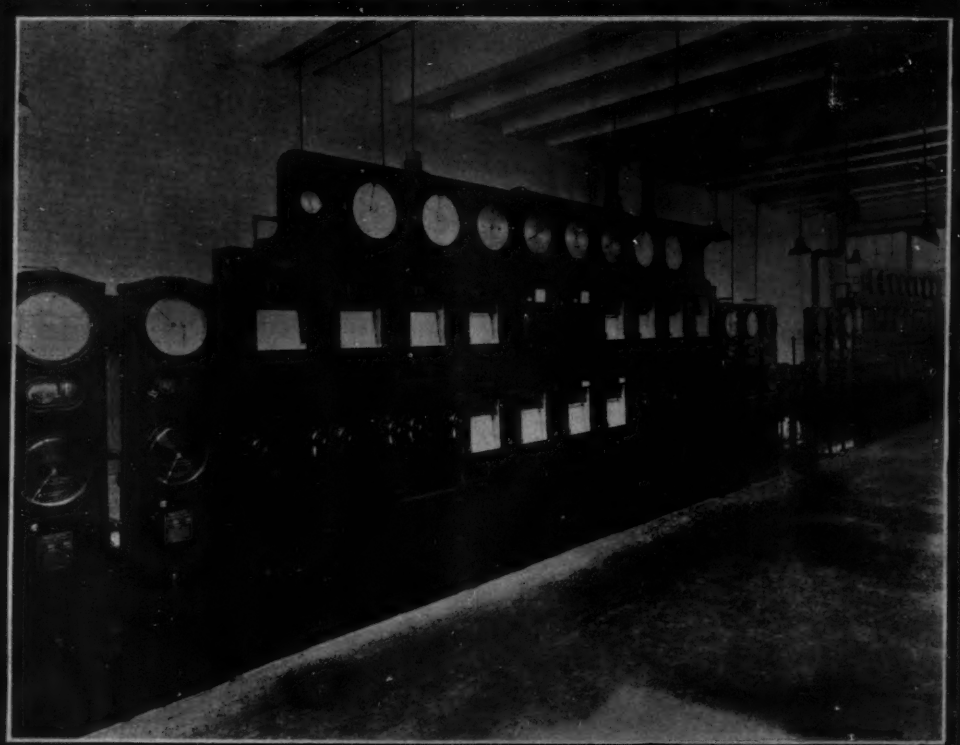

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of lubricants is now receiving considerable attention by refiners in the Mid-Continent and products now being manufactured from such crudes can equal lubricants made from Pennsylvania oil by selecting a crude that has a high paraffin content. Such crudes as Seminole and Oklahoma City have a low percentage of asphalt but yet too high to make bright stocks by the usual method without high acid sludge losses during treating. This difficulty has been largely overcome by the use of vacuum distilling equipment which is capable of taking the steam refined stock overhead. In this way a separation is made between the asphalt and lubricating stocks. In order to accomplish the most in this type of distillation, the problems involved must be carefully considered. Most of these units involve the use of pipe stills with high liquid velocity through the tubes and short time heatnig. The hot oil and vapors are discharged into a fractionating column operating at reduced pressures. The vapors are fractionated in the usual manner into gas oil, pressable wax distillate, slop wax and steam refined stock. The steam refined stock is then diluted, and centrifuged for wax extraction. This material must then be acid treated and filtered and the use of mechanical mixers and centrifugal separation of the acid sludge have aided materially in improving the product. Neutralization is usually accomplished by contact filtering.

By the further perfected use of the above process high quality bright stocks can be produced from the relatively low priced mixed base crudes and such oil will become a competitor in the field now enjoyed only by Pennsylvania stocks.

Crystallization of Wax in Paraffin Distillate

By HAROLD J. DUNMIRE
Valvoline Oil Company

Before National Petroleum Association, Cleveland, Ohio, April 24, 1930

THE purpose of this paper is to point out some of the factors governing the crystallization of paraffin wax. The work outlined here was carried out in laboratory size apparatus where conditions governing the various experiments could be easily controlled. No attempt is made to enumerate the different theories advanced on the subject by men who have done various amounts of research in the petroleum industry, nor is any attempt being made to discredit any of those theories. Instead, I am merely outlining the work done, together with results obtained, and the observations made while obtaining those results.

For many years it was thought that "cracking" was essential to the manufacture of wax distillate. Refiners took their wax distillate cut from the crude, and rerun this cut in a so-called cracking still, to obtain the desired crystalline form of wax necessary in a pressable paraffin distillate. Later, the primary cut from the crude was segregated so that only part had to be cracked in order to make the distillate pressable. More recently refiners who can distil their paraffin distillate cut through a bubble tower have obtained a pressable distillate on the primary distillation. It was decided to prove, if possible, just what effect cracking had, and what effect fractionation had, upon the manufacture of good wax distillate.

A Spencer microscope, equipped with Bausch and Lomb camera, was used in this work for obtaining photomicrographs of the wax crystals. Polarized light was obtained by means of crossed Nicol prisms. This apparatus had been in daily use for some time in conjunction with regular plant operation; therefore the experience already obtained in judging the photomicrographs insures a fairly correct analysis.

A quantity of paraffin distillate was prepared by taking a deep cut from West Virginia P. G. crude, under vacuum, in a pipe still. This method was used to eliminate cracking as much as possible. The cut obtained will be referred to hereafter as uncracked paraffin distillate stock.

To determine the effect of fractionation a portion of the above prepared stock was distilled under vacuum (10m.m. of mercury pressure) and five per cent cuts collected. The apparatus used consisted of a regular Engler distillation flask, well insulated, with the heat applied in such a manner that there was only a small temperature drop between the liquid in the flask and the vapors entering the condenser. The distillation was

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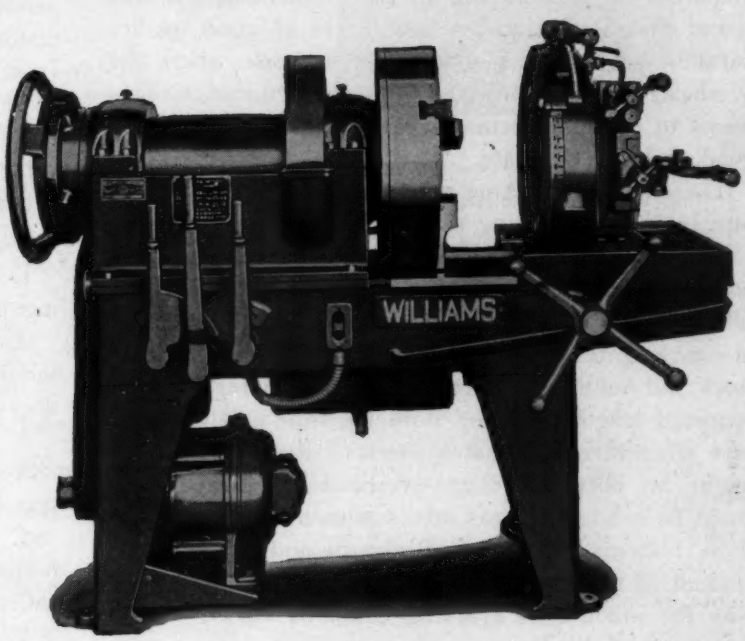

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carried out rapidly so that poor fractionation of the overhead distillate resulted. The five per cent cuts were prepared for photomicrographing in such a manner that the first sample was composed of the first five per cent; the second sample was a blend of the first and second; and the third sample was a blend of the first, second, and third cuts; or in other words the third sample represented the first 15 per cent over. In like manner blends were made up from all of the five per cent cuts so that photomicrographs of each blend could be taken to determine the maximum percentage of good pressable distillate obtainable with poor fractionation.

SECOND PORTION RERUN

A second portion of the uncracked paraffin distillate stock was rerun, under 10 m.m. mercury pressure, through a high packed tower carefully controlled in order to secure good fractionation of the overhead. The cuts were collected in five per cent lots, as before, and prepared for photomicrographing by blending. It was found that almost 20 per cent more of good quality paraffin distillate was obtained in the case where the overhead had been subjected to good fractionation. This seems to be an important factor in the preparation of good pressable distillate.

The effect of cracking was studied by preparing the sample in the following manner:

An autoclave capable of withstanding several hundred pounds pressure was used for cracking the paraffin distillate stock. The operation of this autoclave consisted in charging the required amount of paraffin distillate stock and holding the temperature desired for a predetermined length of time. Both the time and temperature were varied so that a check of these two factors might be obtained. Any overhead resulting, which could be condensed, was mixed with the bottoms after these bottoms had been withdrawn and cooled. The amount of this overhead in all cases was small. In this way the amount of cracking could be varied with a minimum of distillation.

The different samples obtained above were rerun under 10 m.m. of mercury pressure, both with and without fractionation, as previously explained. As in the case of the uncracked paraffin distillate stock, samples were taken in five per cent cuts and blended for photomicrographic analysis. The results indicated that time was more important than temperature after cracking temperatures had been reached. The cracked samples showed increases in the percentage of pressable distillate over that obtained from uncracked stock both in the case of those distilled with and without fractionation, but the percentage was lower in the case of all cracked samples when rerun without fractionation than that obtained when rerunning the raw distillate with good fractionation. This would tend to prove that fractionation is more important than cracking when rerunning paraffin distillate. It would also tend to show that fractionation eliminates a high boiling substance which inhibits crystallization and that cracking either destroys or breaks up this high boiling material.

The maximum amount of pressable paraffin distillate can be obtained with:

1. Cracking and good fractionation.
2. Good fractionation.
3. Cracking and poor fractionation.
4. Poor fractionation.

The yield in per cent did not show as great a difference between one and two as between two and three, indicating that, while cracking was desirable, it was not as beneficial as good fractionation. The combination of both yields the maximum desirability.

PARAFFIN SAMPLES PHOTOGRAPHED

Paraffin distillate samples obtained from several different crudes were photographed under the microscope so that a comparison of their crystal sizes and shapes could be made. The sizes varied, at the point of crystallization, from .0005 inch to .01 inch long, depending upon the crude and the manner in which the distillate was made. The shape of the crystals varied from long thin needles to flaky crystals of very large sizes. The shapes depended to a large extent upon the nature of the crude. Generally speaking, though, the wax in all crudes appeared to be essentially the same.

While working on the above problem, observations were made which might be summed up as follows:

1. That fractionation is more important than cracking in the manufacture of good wax distillate.
2. That all petroleum wax is of the same type of material. So-called amorphous wax, as a distinct type does not exist.
3. Petroleum wax is naturally very crystalline, and if its tendency to crystallize is not suppressed, the formation of good crystals will result.
4. The presence of a colloid, or high boiling material, inhibits the formation of good crystals, causing the so-called amorphous condition to result.
5. This high boiling colloid can be separated from the waxes by high vacuum distillation, without decomposition, provided the colloid is not carried over by entrainment.

The exact nature of the interfering colloid is problematical, but there is evidently more than one type; and at least one effective type is colorless and lacking in absorptive properties. Should it be possible to remove the crystal inhibitors, either by absorption or by chemical treatment, the wax could be removed by the regular pressing operation. This would eliminate the necessity of cold settling plants and expensive centrifuging installations. Ordinary filtration through Fullers earth will tend to remove some of the interfering colloid.

In conclusion it might be well to restate what has been explained above, that good quality pressable paraffin distillate can be prepared from the crude without decomposition provided the paraffin distillate cut has been fractionated sufficiently to eliminate possibility of an excessive amount of the high boiling crystal inhibitors being carried over by entrainment.

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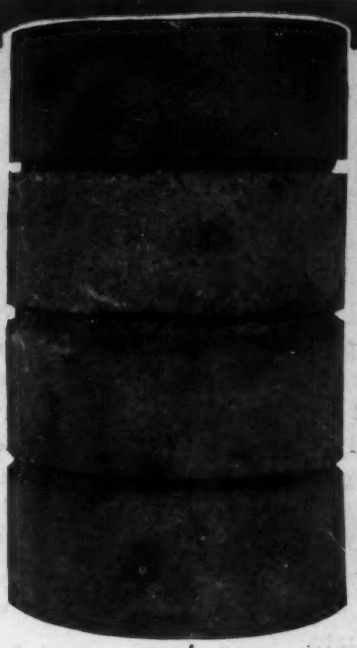

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Scientific Research

By G. C. DAVISON,
Trustee in Charge, Department of Scientific Research

Before National Petroleum Association, Cleveland, Ohio, April 24, 1930

THE Department of Scientific Research has been in existence only about a year, so that this happens to be the first report of that department to our association. I have never yet quite figured out how I happened to be put in this position, but I believe I begin to see light, as I have a letter from our good general counsel telling me he believed I had a sense of humor and that a little humor sprinkled in with our work is a good thing for the association.

Anyway, nearly all our work has a humorous side if we can only see it, and those who can see it are fortunate.

I feel a strong temptation to digress and point out some of the very humorous situations that have arisen, especially in connection with the code of ethics. The marketing business had reached such a state that many of the individuals engaged therein certainly never knew the meaning of the word ethics. Or if they did, they had to forget it if they wanted to stay in business. Nevertheless, it is a grand piece of work and we are all learning something. In the same way, as far as I can make out, real honest-to-goodness scientific research in the industry seems to be about as new as marketing ethics. I gather this impression in many different ways.

Your department, with the assistance of the officers of the association held a conference in Washington something over a year ago, which conference was attended by technical representatives. We all agreed one hundred per cent that scientific research should be conducted and that it should not cost anybody a nickel. We, therefore, unanimously voted to pass the buck to the Bureau of Mines. We made an official call on the Bureau of Mines, had a very polite reception, but were told that there was nothing doing unless we put up the price, some $40,000 or $50,000 I believe it was. That settled that.

The particular program we decided upon to be carried out at the government's expenses, was what might be called the preparation of a digest or abstract of the best scientific literature on the general subjects. It was to be more than a mere biography and would have required some very able scientific minds to cull through the vast amount of scattered material and concentrate it in one volume, with notes giving references to the original articles or papers. It would have been a magnificent piece of work if your committee's ideas could have been carried out by the government, free of expense to us.

After this piece of work, your committee took a rest but kept its eyes open, and finally got on the trail of another very promising and even more important project. This new project was none other than the practical application of physical and chemical thermo-dynamics to petroleum refining. Our attention was first called to this project by Dr. Francis who has contributed some very valuable papers on the subject which have been published in Chemical Engineering, the monthly organ of the American Chemical Society. Dr. Francis is employed by Arthur D. Little, Inc., of whom you all know and apparently has paid much attention to this subject, and appears to your committee to have started something of vital importance to the future welfare of the industry and to the world in general. At the last meeting of the American Petroleum Institute in Chicago last December, Dr. Francis read a very important paper on this subject. Your committee has since been in correspondence with him and has also taken the matter up with the American Petroleum Institute and has met with the greatest encouragement. Dr. Anderson of the institute has shown the greatest willingness to cooperate within the means available and while nothing definite has yet been settled, the matter has not been dropped, and it is ultimately hoped that some means will be found to carry out the practical work necessary in order to apply the principles of thermo-dynamics to petroleum processes.

TECHNICAL REPRESENTATIVES PRESENT

Many of your technical representatives here present, of course, are familiar with the meaning of thermo-dynamics just as much as your principal executives are familiar with the meaning of the word ethics, but there are others, through no fault of their own, who are not so familiar with the word thermo-dynamics, and I would, therefore, like to give a brief sketch of the history of this science and what it may mean in a practical way to the industry.

Thermo-dynamics is not a new science. The foun-

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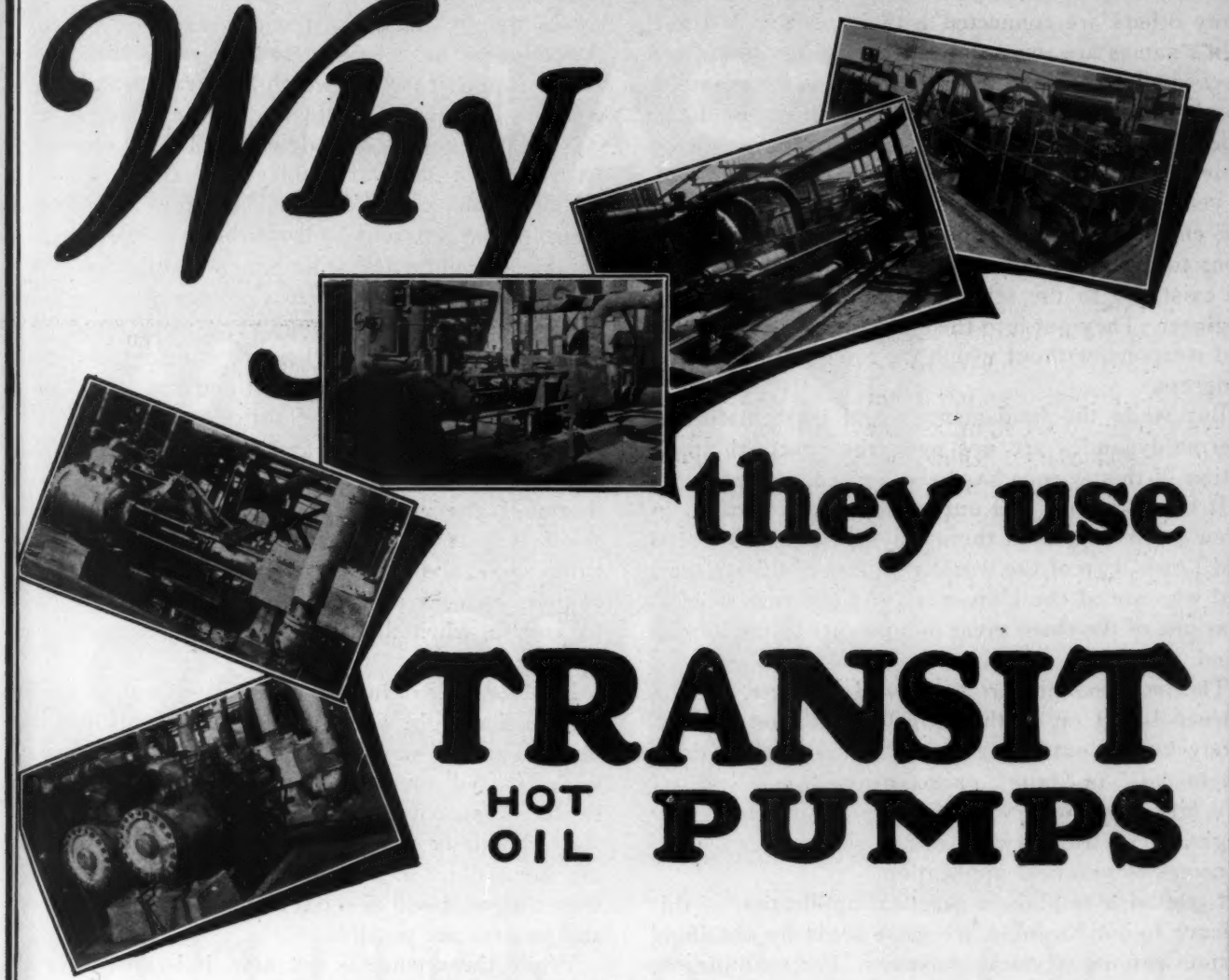

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dations for it were laid in the latter half of the nineteenth century and many of the most familiar names, such as Carnot, Joule, Kelvin, Claussius, and many others are connected with it. Many of these men's names are immortalized by having new units discovered and named for them, such as for example, the Joule, or the mechanical equivalent of heat. These men broke down the barrier of ignorance which had been holding back the world for millions of years and let in scientific light which has enabled the engineers and scientists of succeeding generations to develop our modern civilization which owes its existance to the scientists, the inventor and the engineer. They put into the hands of these men tools and weapons, without which we could have made no progress.

But while the fundamentals and mathematics of thermo-dynamics are not new, the practical application of this science has been limited.

It is impossible, and out of place to try to tell in a few words just what thermo-dynamies are. Randall and Lewis, two of the world's leaders of this science, and who are at the University of California refer to it as one of the three great monuments to the human mind.

Thermo-dynamics are exact and absolute. It is a science based on mathematical application of definitely known natural laws. So far as it goes, there are no "ifs" or "buts", or exceptions.

While the glossary of this science covers many pages, there are a few terms which stand out when it comes to practical application.

If we wish to make a practical application of this science to our business, we must begin by obtaining certain definite physical constants. For example, we may have a substance, let us say, octane. The first thing we should know about this particular material is its heat capacity at different temperatures. Such heat capacity has been determined for a great many permanent molecules, but only a few of the many hydro-carbons have ever had this simple fundamental quality determined. It sounds simple, but first of all the substance must be isolated before its specific heat or heat capacity can be determined. This means considerable work and expense. We know the heat capacity for a few of our hydro-carbons, such as methane.

Another very important physical constant which must be determined is the equilibrium constant. This is a definite physical quality which can also be measured by various processes, but especially by what is known as dissociation. Knowing these two definite physical qualities of any substance, it is then possible to deduce from them what are known as integration constants and to establish thermo-dynamics formulae for free energies, etc.

NEED NOT REPEAT WORK

After having determined these physical constants we then have something which is good for all time. The work need never be repeated if it is obtained accurately in the first place and can be used over and over again, in making calculations as regards processes and treatments of the various substances. At this time we have very little data along these lines. It is this practical work which Dr. Francis and others who are interested, would like to see done.

Now after having once determined these constants, let us say not necessarily for every variety of hydro-carbon we have at a refinery, but for a number of them, in the different hydro-carbon families such as parafines, naphthenes, olifines, and many others. We could interpolate with great accuracy intervening substances, so the total amount of work involved is not so great after all, when we consider the enormous field that can be covered and the actual practical results which may be anticipated, provided the work is done right in the first place and proper application is made later. In some instances in the past, thermo-dynamics have received a black eye due to the fact that some of its advocates became over-enthusiastic and substituted guess work and theories of their own for actual physical and chemical facts. Of course, when this was done some of them went wrong.

In other lines of industry, thermo-dynamics are being applied right along with splendid results. Immense sums of money which would otherwise have been wasted or fruitless experiments have been saved, because thermo-dynamics have been able to state definitely when certain reactions or processes are impossible or impractical. But it can do more than this, as it will also tell us when certain reactions and process are possible.

While the science is not new, it is still after all, incomplete. The foundation is on solid ground and will last forever, but the complete edifice has not yet been built. At the present time thermo-dynamics do not deal with the time element. While it will truthfully tell whether or not a certain reaction at a certain temperature is possible, it is silent on the question of time required. It gives us an answer in the form of what is called free energy. It tells us whether a certain product will be stable or unstable at certain temperatures. It tells us whether or not certain products can be formed, but does not tell us how long it will take to form them. Possibly some day, some great mind will make another generalization and have his name added to those of the immortals who have gone before. But whether or not these future generalizations or discoveries are ever made, we already have enough solid foundation on which to build, and to create in the petroleum industry an exact science which will result in better methods, better products and unquestionably new and more valuable products.

GREAT VARIETY OF VIEWS

When one sits in and listens to some of the technical meetings and discussions pertaining to cracking

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or when he goes around in the industry discussing this matter with different individuals, he is impressed with the great variety of views and beliefs that are held. One cannot but help be also impressed with the great range of pressures and temperatures which are used in the cracking processes, which are covered by some six thousand or more patents. And when one hears some of these spirited discussions as to what is true and what is not true, one can only draw the conclusion that the subject is not thoroughly understood fundamentally. If it were, and the fundamental principles and facts thoroughly understood, we would have no room for these discussions. The same thing is true for other phases of refining. The possibilities of the future are over-whelming. Refining today is carried on in an emperical manner, and new facts are being discovered almost daily. There are possibilities of synthetic processes as well as processes of dissociation, or of cracking. One process may be called constructive and the other destructive. In fact, the two processes sometime go along simultaneously. While certain molecules are being destroyed other molecules are being constructed, both of higher and lower order than those started out with. If the practical application of thermo-dynamics were worked out in accordance with our present known fundamental laws, it is more than likely that millions of dollars could be saved to the industry.

It is practically certain, for example, that certain vapor phase cracking processes which now form an undue proportion of fixed gases which are a waste and have to be burned as fuel could be greatly improved so that the yield of fixed gases would be cut down and the yield of motor fuel could be greatly increased. In fact, one cracking process claims to have done just this. The fundamental laws of thermo-dynamics check and point to this being possible. In the same way, control of other products can doubtless be obtained if we had, to begin with, the necessary information as regards physical constants.

The question of the use of higher pressures to obtain certain products, as for example, in the hydrogenization process, can all be answered definitely by thermo-dynamics. For example, let us say we have a reaction which thermo-dynamics show to be impossible at ordinary pressures. Thermo-dynamics will give the answer as to whether this same process would be feasible under some abnormally high pressure, say 100 or 1,000 atmospheres.

In a recent issue of the National Petroleum News, Colonel Burrell wrote an article on this subject. This article dealt more with generalities and with the work of Dr. Francis. Dr. Francis apparently is not a refinery man and the charts he published and the work he did were evidently based on pure science, with very little exact data to begin with. Nevertheless, Dr. Francis made certain predictions and statements and Colonel Burrell in his article compared them with actual practice and shows that they were in the main correct.

PETROLEUM INDUSTRY COMPLEX

There is no chemical industry which is so complex, which involves so many different chemical reactions, and which deals with so many complex mixtures as the petroleum industry. Yet there is little doubt that all of these apparent complexities are governed by simple natural laws and that most of these laws are already known in the science of thermo-dynamics. Therefore, it is hard to think of any more intriguing or interesting problem than to take this very complex material with which we deal, split off some of its components, find out just what their physical characteristics are and then finally to develop processes which apply known laws and which will make these complex mixtures straighten themselves out and form themselves into the substances we want.

Work along this line is going on rapidly. Our petroleum hydro-carbons contain the basis of very many valuable chemicals. The addition of one oxygen atom to parafine hydro-carbons gives us a whole range of alcohols. One of our great chemical companies is now making from fixed gases derived from a Gyro cracking plant, large quantities of pure drinkable alcohol C_2H_5OH.

When one thinks of the immense commercial possibilities of using petroleum hydro-carbons as a base, and by adding an atom of this or an atom of that and making an immense number of commercial chemicals which are in daily use and which sell at anywhere from 50 cents to several dollars per gallon, one must tremble for some of the other industries. One recent development is in connection with adding two atoms of oxygen to hydro-carbons. When this is done, we can get a series of fatty acids. A process has recently been worked out and turned over to one of our largest soap manufacturers who has perfected it to a point where the fatty acid he prduces is perfect in every respect in regard to odor. If we read chemical abstracts and other information, especially patents, it is apparent that thousands of minds are working along these lines, most of them in the dark and by emperical methods, but progress is being made. Present progress might be compared to that of a navigator exploring an unknown archipelago without a chart. By sailing around, he is almost bound to make some discoveries. Some day, enough of these discoveries will be made, and put together, and when correlated by the science of thermo-dynamics, we will have a complete chart and it will then be clear sailing.

Your department of scientific research hopes that it can do its bit by encouraging and helping these scientists who are willing and anxious to measure, or ascertain the necessary physical data, and then put it together in such a way as to be of practical use to the industry. The great beauty of this work is that it is all fundamental, exact, and when once done will be good for all time and of permanent benefit, not only to our industry, but to the whole civilized world.

Chemical Treatment of Petroleum Distillates

(*Continued from page* 96)

In concluding this general discussion of sulphur it may be said that the whole question of sulphur content of finished products, and hence the whole question of chemical treatment for sulphur in various forms is at present an open subject for debate between the various interests involved. There are those who contend that the limits are set too low on gasolines in view of the high percentages used in European countries where benzol is largely used as a motor fuel, without any greater apparent detrimental effects upon motors. It is pointed out that chemical treatment adds to the cost, and therefore the price of gasoline in two different ways. First, in the cost of chemicals and treatment, and second, in loss of gasoline. A producer has estimated that if a higher percentage of sulphur could be tolerated in gasoline in this country, refinery losses could be reduced with a net annual gain of gasoline worth $50,000,000 at prices prevailing in 1927. On the other hand an eminent automotive engineer estimated the value of motor cars at that time to be about $14,000,000,000 which makes the added treating cost only about one-third of one per cent of the capital thus invested, which does not seem to be a high cost for insurance against the corrosion which might be caused by the higher limit set on sulphur.

An investigator for one of the largest manufacturers and marketers of gasoline studied the effects of increasing percentages of sulphur on motors and concluded that percentages above the commonly accepted maximum of one-tenth per cent do cause appreciable damage, and that the increasing damage above that limit is greater than a proportionate increase in sulphur would lead one to expect. Other investigators find that the amount of corrosion from sulphur is more closely related to temperature than to percentage of sulphur, concluding that condensation and accumulation in the crankcase is the evil to be overcome. From the manufacturer of motors we find encouraging developments along the line of crankcase ventilation, oil filtering, and rectification, which promise greater protection along this line because the mechanical problems of lubrication are intimately tied up with the chemical problems of corrosion.

The final answer awaits further definite investigation and developments in both the automotive and petroleum industries. In the final analysis the old economic law of supply and demand, determining conditions of competition, and the general attitudes of producer and consumer, will play an important role. Certain it is that at the present time, no manufacturer is going to overlook anything that bears the semblance of an appeal to the consumer to buy. These conditions are inevitably expressed in narrowing and more exacting specifications.

West Texas Gasoline Plant Men Meet a Breckenridge

NATURAL gasoline plant operators of the Central West Texas territory had their annual meeting in Breckenridge, April 22, under auspices of the Natural Gasoline Association of America. Both morning and afternoon sessions were devoted to the presentation and discussion of subjects of vital interest to men who are employed in natural gasoline manufacture.

Those attending the meeting were guests of the Chestnut & Smith Corporation for an army style luncheon at the Breckenridge Y. M. C. A.

The meeting was opened in the Breckenridge City Hall by Dr. E. R. Lederer, president of the Natural Gasoline Association of America and vice president of Texas Pacific Coal & Oil Company. He outlined the purpose of the meeting and then introduced John Z. Martin, secretary of the Breckenridge Chamber of Commerce, who extended an invitation to his hearers to make use of the civic facilities of the city. Charles F. Clark, mayor of Breckenridge, gave the address of welcome and paid tribute to the part the natural gasoline industry has played in building that city.

L. D. Scarborough of the Hartford Steam Boiler & Inspection Company, Dallas, gave the first technical discussion on "Boiler Operation and Maintenance." His subject was limited chiefly to safety valve factors, the holding of proper water levels to avoid excessive evaporation losses; proper installation of steam headers; emptying and filling of boilers, precautions against flarebacks in lighting; safe rules to follow in case of low water and how to set up boilers for storage.

E. E. Stovall of Lone Star Gas Company, Dallas, read a paper on "Meters and Their Operation," which dealt largely with the installation and care of these devices, with an introduction on the two types of meters.

The subject "Care and Operation of Gasoline Plant Machinery," was presented by D. B. Hiatt of the Texas Pacific Coal & Oil Company, Thurber.

E. H. Triphaus of Taylor Instrument Company, Dallas, offered the subject "Regulators and Controlling Devices."

Two discussions of the subject of safety were on the program, one by H. N. Blakeslee of the National Safety Council, and D. J. Wallace, director of the safety division of the Mid-Continent Oil & Gas Association.

The subject of shipping was offered by Otto Peters of Brooks & Hanlon, Inc., Breckenridge, his subject being "The Practical Side of Shipping Natural Gasoline."

There were opportunities for discussion following all these papers.

OIL WELL-FIELD AND REFINERY VALVES

Powell Bronze, Iron and Steel, Globe, Angle, Cross, Check, Gate and Safety Valves have become the adopted standard for oil well, field and refinery service. They are processed to be oil and gas tight; they are adapted for handling volatile and hazardous liquids and gases. Powell Valves are made in a full range of types and sizes for working pressures of 125 pounds to 2000 pounds - - - for temperatures to 1250° F.

THE WM. POWELL CO.
2521-2531 Spring Grove Ave., Cincinnati, Ohio

POWELL VALVES

The Practical Side of Shipping Natural Gasoline

By OTTO PETERS
Brooks-Hanlon Gasoline Company

Before meeting of plant operators of the Natural Gasoline Association of America, Breckenridge, Texas, April 22, 1930

THERE is much to think of when we load a tank car of natural gasoline.

It is true that the mechanical details are governed by regulations for the transportation of explosives, but there is also the fact that the act of loading at tank car due to its apparent effect on plant production, brings about a relationship to plan operation that calls for close cooperation between the loader and the plant operator in order to protect the factors effecting the plant production. The natural gasoline we load into the tank car is a product obtained after the operation of many expensive and worrysome details, it represents the fruit of labor that involves many hazards, and to load it into the tank car is not by any means the last step as our responsibility for its condition and its safe arrival does not cease until it is accepted at point of destination.

The fundamental property of natural gasoline is its volatility and this presents the great problem of the evaporation and the loading losses while handling at the plant, and the outage losses in shipping. In the summer months loading losses may be from 10 to 15 per cent as against one to two per cent in the winter months. It is the general practice to trap off the vapors from the tank car while loading in order to handle them with the so-called vapor units of the plant. These vapor compressor units operate at a discharge of 60 to 80 pounds gauge pressure and where the tank car vapors are rich in gasoline content we find in practice that the gross production of the vapor units increases about three gallons per minute per tank car while loading is going on, and this increase amounts to 540 gallons to the car that takes three hours to load.

It is essential that the men who have charge of the loading possess qualifications that enable them to visualize the responsibility of their work. Their skill and their initiative enable them to save great losses, and an appreciation of their responsibility enables them to cooperate closely with the plant operator by seeing to it that the vapor units are ready to handle the tank car vapors. To conduct the loading rack work calls for knowledge and loyalty in the conservation of company interests, as the slightest neglect or error brings about a loss in some form that can not be regained.

In 1922 the Bureau of Explosives issued pamphlet No. 9 showing Interstate Commerce Commission Regulations for the Transportation of Explosives etc. and it was revised, effective January 1, 1923.

The Natural Gasoline Association of America has available for those concerned a bulletin entitled "Shipping Instructions for the Transportation of Explosives and Other Dangerous Articles" which contains full instructions for the loading and the unloading of tank cars and it also contains full description of the "Standard Procedure for Determining the Vapor Pressure of Gasoline by the Reid Method." Copies of this bulletin may be obtained by addressing Ray Miller, secretary of the association.

DIFFERENCES

Technical Paper 323-B, United States Government Specification No. 2-D, entitled "United States Government Master Specification for Lubricants and Liquid Fuels" contains on page 49 the distillation of gasoline in accordance with method 100.13 applicable to the distillation of naphtha, kerosene, and similar petroleum products, in which is outlined the necessary apparatus and procedure of distillation, and I call your particular attention to page 54 paragraph 10 on Accuracy and paragraph 11 on Correction for Barometric Pressure.

The Natural Gasoline Association of America has developed and adopted "Official Specifications and Test Methods for Natural Gasoline" in which is outlined the five specified grades of natural gasoline manufactured by the gasoline plants, as well as the Distillation Test, the Doctor Test, the Corrosion Test, and an Abridged Volume Correction Table.

The difference in the distillation of gasoline between that specified in Technical Paper 323-B and that of the Natural Gasoline Association bulletin lies in the following factors:

First—Maintaining a lower temperature on the sample taken for distillation.

Second—Holding a lower maximum temperature on the condenser bath and using air agitation.

Third—Lower temperature maintained on receiving bath.

Fourth—Difference in time allowed for first drop over to obtain initial boiling point.

Fifth—Obtaining the residue at a specified temperature.

For your ready information I submit a comparison of distillation on natural gasoline and a motor fuel that has been blended with natural gasoline. One is from the laboratory of a gasoline plant and the other is copied from a refinery record and it happens that the factors

of difference in the distillation methods is strikingly illustrated.

GRADE BB

	Natural Gasoline	Blended Motor Fuel
Gravity	87.6@60	60@60
Temperature of Condenser	32	34
Temperature of room	71	76
C. C. Tested	100@32	100@64
Initial Boiling Point	57	98
Initial Boiling Point time obtained	3′	7′3″
Maximum Temperature	341	396
Residue	0.6	0.9
Loss	14.1	2.0
Color	25-Plus	25-Plus
Doctor	Negative	Negative
Bath	33	58 to 61
Barometer	28.23″	28.23″
Standard Vapor Tension at 70°F.	7 lbs.	1.7 lbs.
Standard Vapor Tension at 100°F.	14.5 lbs	5.6 lbs.
REID VAPOR PRESSURE at 100°F.	29.0 lbs.	6.0 lbs.

The curve on these distillations is as follows:

Natural Gasoline		Blended Motor Fuel	
% Over	Temperature	% Over	Temperature
5	63	5	127
10	68	10	148
20	76	20	182
30	87	30	213
40	101	40	238
50	123	50	262
60	148	60	284
70	184	70	308
80	230	80	332
85.3	341	90	360
		97.3	396

In the two distillations you will note the difference in temperatures for the same per cent recovery. This difference shows the lighter hydrocarbons in the natural gasoline and for this reason it is absolutely essential that the method of distillation test be strictly adhered to. These lighter hydrocarbons cause all the losses involved and an error in distillation from any cause aggravates the matter, furthermore, in shipping to a higher altitude the recovery of the natural gasoline is effected due to the presence of the lighter hydrocarbons which adds to the problems of the natural gasoline manufacturer

Form 144—30M Sets—9-28.

LABORATORY TEST

No.

Product Tested Finished Motor Fuel

Thermometer No. 7-H222933

Gravity 60.5 @ 64 : 60.0 @ 60 °Be

Temp. Cond. 34 °F. Temp. Room 76 °F.

CC. tested 100 @ 64

Initial 98 °F.

Dry Point ✓ °F. Max. Temp. 396 °F.

Residue 0.9 % Loss 2.0 %

Color +25 Odor ✓

Doctor Negative

Flash ✓ °F. Fire ✓ °F.

Tested at B + H Lab.

By W. J. Van Bibber

Approved

Shipped from

To At

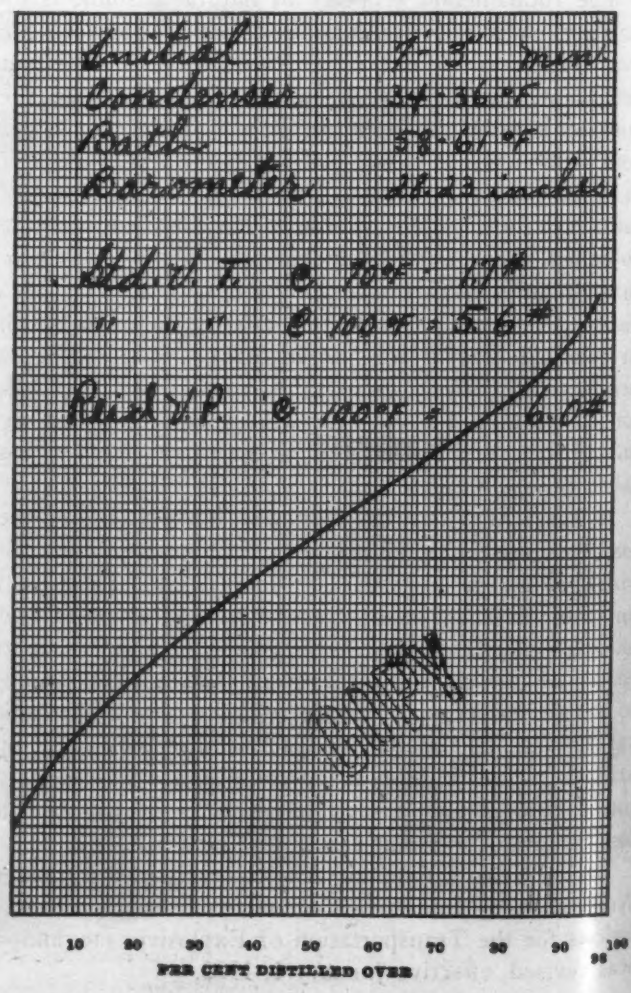
% Over	Temp. °F.
5	127
10	148
20	182
30	213
40	238
50	262
60	284
70	308
80	332
90	360
97.3	396

COPY

Car No. Init. Date March 6 1930

Initial Condenser 34 °F.
Bath 58-61 °F.
Barometer 28.23 inches

Rid V.P. @ 100°F. = 6.0#



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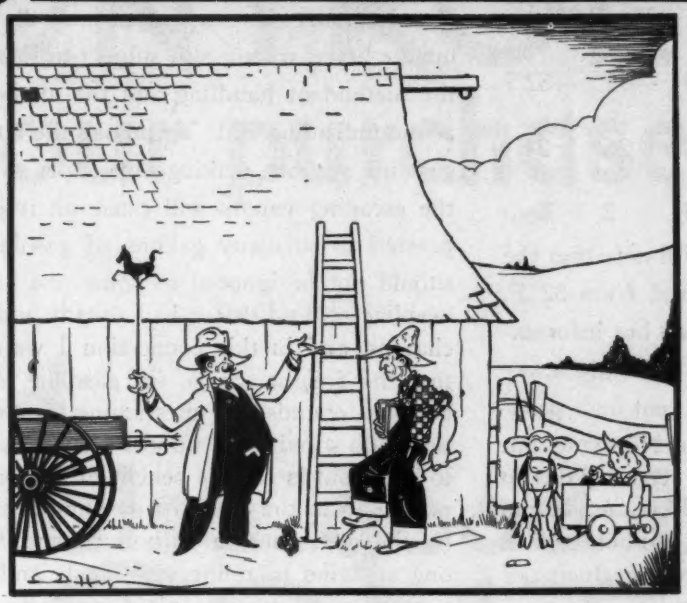
Billions of Bubbles



Putting up an Argument

REMEMBER the lightning rod dispenser back in your green-apple days? Despite the old rascal's questionable practices, he did have an unmeetable argument—barns equipped with his rods never got hit by lightning.

But what has this to do with the Wright Oil Well Pump?

Just this: The Wright Oil Well Pump, likewise, has an unmeetable argument. It produces more oil without having to be pulled and serviced than any other pump on the market . . . so much more that the difference pays for the pump in a remarkably short time.

How is that?

By means of an ingeniously devised magazine, fresh packing is fed out as quickly as the old is worn away. And the pump stays on the job.

"A pump is a pump only when it's pumping."

The Wright Oil Well Pump is fully described in Bulletin No. 8. Write for your copy today.

J. A. CAMPBELL CO.

Natural Gas Engineers

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CONSTRUCTING

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P.O. DRAWER 669
LONG BEACH, CAL.

STEARNS-ROGER MFG. CO., DENVER
MID-CONTINENT AGENCY

Originators of Oil-Froth Absorbers

and the following table shows the boiling points of these lighter hydrocarbons, using as a base one-tenth-inch of mercury per 90 feet increase in elevation above sea level.

All temperatures in Fahrenheit

	At Sea Level	1000 Feet	2000 Feet	3000 Feet	4000 Feet
Boiling Point of Propane	Minus 45.5	—47	—49	—51	—52.5
Boiling Point of Normal Butane.	Plus 32	30	28	26	24
Boiling Point of Iso-Butane	Plus 8	6	4	2	Zero

By referring to the above table you will note that the boiling point of normal butane is lowered from 32°F. at sea level to 24°F. at 4000 feet elevation but information at hand shows that this difference will only lower the distillation recovery about three per cent on a product containing approximately 35 per cent N-butane, but there will be a decided difference in the recovery due to the presence of varying amounts of iso-butane. It can be safely assumed that three per cent iso-butane will lower the distillation recovery five per cent exclusive of the effect of altitude in the n-butane content.

UNLOADING CARE ESSENTIAL

Assuming that the natural gasoline has been manufactured and loaded in accordance with specifications, we are still confronted with losses apparently beyond our control. After all precautions have been taken to guard against the evaporation and the loading and the outage losses we are still subject to losses occasioned by the method of handling and the method of distillation at the unloading end. To unload the tank car of natural gasoline without making any effort to prevent or save the escaping vapors will cause an irreparable loss expressed in so many gallons of gasoline, and this loss should not be ignored as some one has to pay for it, keeping in mind that it has already added to the freight charges, and in this connection I want to remind you that the freight charge for gasoline is based upon the hundred pounds. In questioning the method of distillation I do so with the utmost respect as the point I wish to bring out is for the benefit of all concerned, and that point lays in the detail of gasoline distillation as shown by the difference in authorized specifications, namely, one applying to refinery products and one applying in particular to gasoline plant products. It follows that

Form 144—30M Sets—9-28

LABORATORY TEST

No.

Product Tested Natural Gasoline

Thermometer No. 7-A 373188

Gravity 82.9 @ 32.° - 87.6 @ 60 Be

Temp.Cond. 32 °F. Temp.Room 71 °F.

CC. tested 100 @ 32

Initial 57 °F.

Dry Point ✓ °F. Max. Temp. 341 °F.

Residue 0.6 % Loss 1.47 %

Color +25 Odor ✓

Doctor negative

Flash ✓ °F. Fire ✓ °F.

Tested at

By

Approved

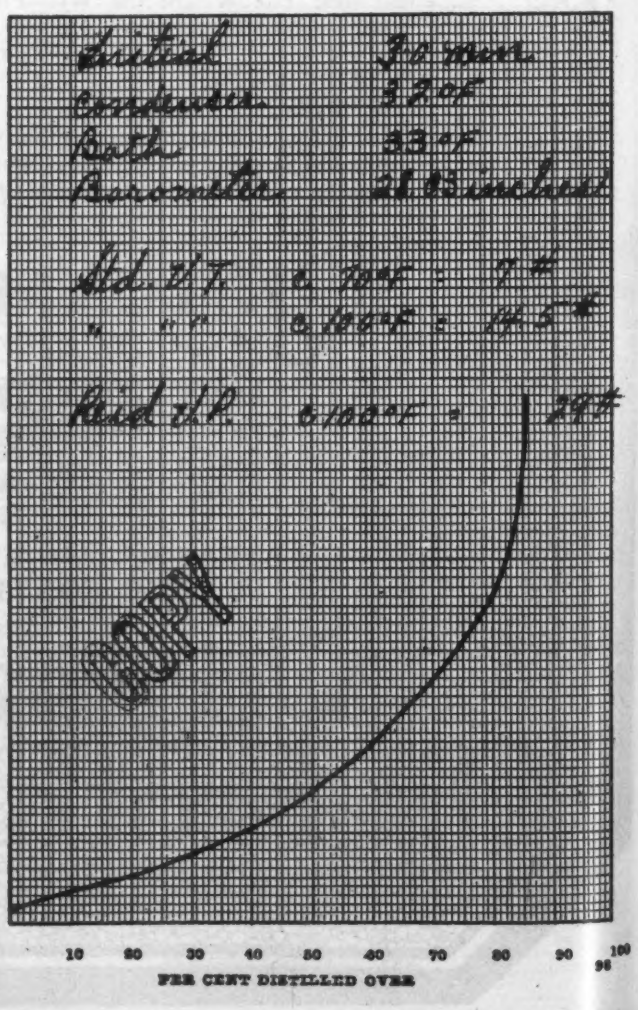
Shipped from

To At

% Over	Temp. °F.
5	63
10	68
20	76
30	87
40	101
50	123
60	148
70	184
80	230
85.3	341

COPY

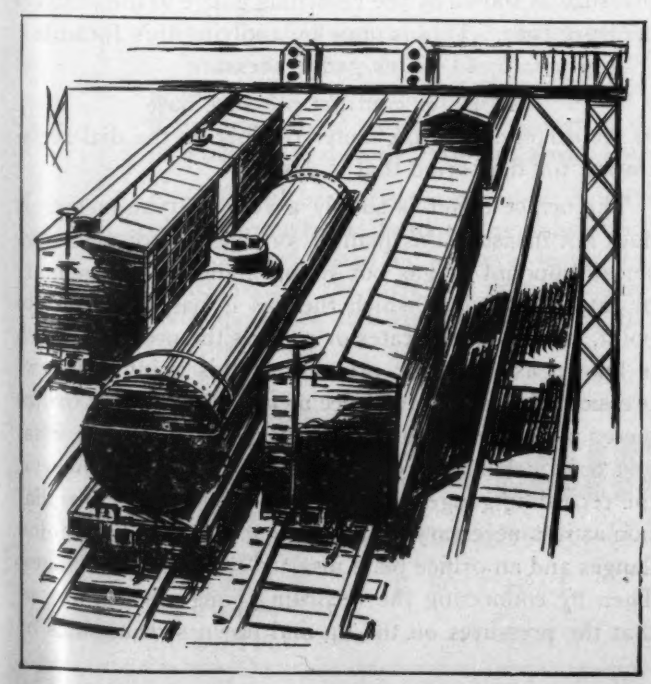
Car No. Init. Date March 6 1923 0



COPY

It is Sound Business to CONTROL your purchases

—and It is also good business to CONTROL the CARS in which your products are shipped



IF you have not yet fully investigated the matter of **car leasing,** you owe it to yourself to do so now . . . A car lease gives you all the privileges of car-ownership at a definite and reasonable monthly cost—freedom from "run-of-the-line" equipment; facilities adapted to your specific requirements and, most important, a type of car—modern and in good condition — in keeping with the quality of the cargo it carries.

We have facts and figures that will interest you. May we present them?

North American Car Corporation

Executive Offices: CHICAGO, ILLINOIS

Car Shops		Bulk Oil Warehouses
Chicago, Ill.	Coffeyville, Kans.	Chicago, Ill
Tulsa, Okla.	North Judson, Ind.	Tulsa, Okla.

where the refinery laboratory is exercising careful forethought in the analysis of its products it may not realize nor appreciate the extreme care needed in making an analysis of a volatile product such as natural gasoline.

We must keep in mind that the shipping of natural gasoline is not a matter of simply loading a tank car. To conserve and protect such a volatile product requires careful handling not only in the loading but also in the unloading of it, and the standard of work calls for knowledge enabling one to anticipate all the factors involved. I look forward for the time to come when through the desire to render service and also for economic reasons the seller and the buyer of natural gasoline will unite for mutual benefit to prevent the great loss now taking place which effects one by paying for the loss and the other losing its use.

Operation of Meters in Natural Gasoline Plants

By E. E. STOVALL
Lone Star Gas Company

Before meeting of plant operators of the Natural Gasoline Association of America, Breckenridge, Texas, April 22, 1930

THERE are two methods of measuring gas that are used, or at least are more commonly known throughout this particular section of the country. They are the positive or displacement meter and the orifice meter measurement.

The positive meter measurement is perhaps not so well known to gasoline plant operators or at least is not used as much as the orifice meter measurement in gasoline plant work as most of the measurement is in large volumes and under low pressure, which would either necessitate a battery of positive meters or the orifice meter.

The positive or displacement meter merely displaces a certain amount of gas which is registered on a direct reading dial through mechanical developments. As the gas enters the meter it creates a rotation of the meter and through a flexible diaphragm mechanism a certain amount of gas is displaced as the diaphragms move in and out in the manner of a bellows. Each time that these diaphragms move in and out a given amount of gas has been passed into the meter and as stated above is registered through a mechanical connection to a dial. In measuring gas under high pressure with a positive meter it is necessary to have a recording pressure gauge attached to the meter in order to obtain the average pressure. This gauge is usually known as a pressure, volume and time gauge. By having this type of gauge you are able to obtain the average pressure and the average rate of flow at all times. Of course it is perhaps possible to use positive meters under vacuum conditions but it would necessitate a special gauge to record the vacuum on the line, and this would decrease the capacity of the meter to such an extent that it would be impractical for this use.

The positive meter is generally used for domestic consumption, small industrial consumption and in gasoline or compressor plant work it is used for measuring fuel gas. The Emco meter manufactured by the Pittsburgh Equitable Meter Company of Pittsburgh, and the Metric meter manufactured by the Metric Metal Works of Erie, Pennsylvania, especially in the larger sizes, are perhaps the most popular positive meters used in this section of the country.

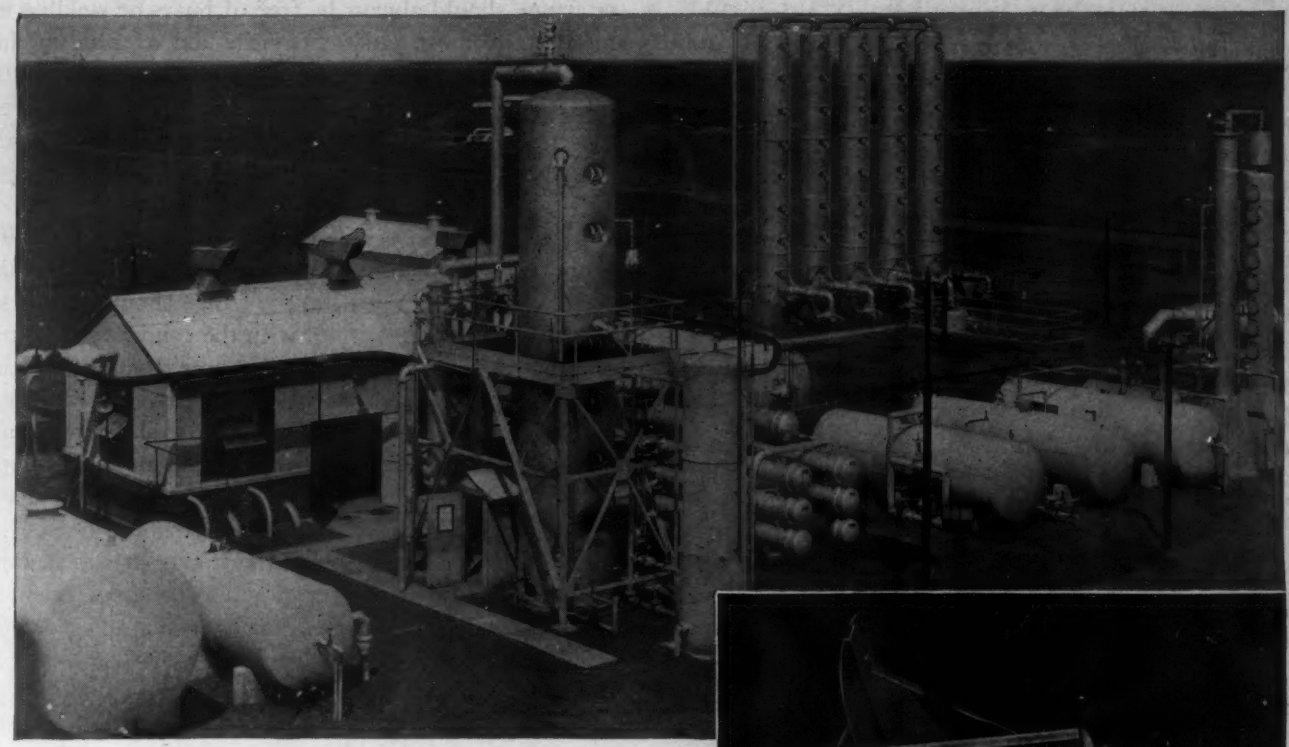
READING THE POSITIVE METER

In computing the amount of gas passing through a positive meter you merely take the reading of the meter at whatever period you desire it to cover. If the pressure on the meter is the same as the contract pressure base the amount passed for a given period of time is the direct reading of the dial. If the meter is operating under a higher pressure than that of the contract pressure base then it is necessary to correct from the average pressure as shown by the recording gauge to the contract pressure base. This is done by applying this formula

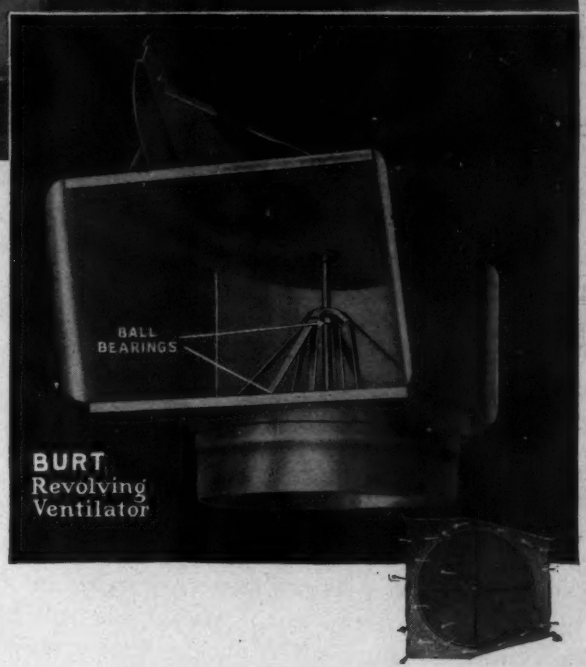
$$\frac{\text{14.4 plus gauge pressure}}{\text{14.4 plus contract pressure base}}$$

to the difference in the meter reading on the dial registration for the period that is desired.

The orifice meter is simply a velocity type meter. It does not measure the quantity or does not displace any certain amount of gas but simply indicates the velocity or rate of speed at which the gas is passing a certain point, and also it indicates or records the pressure which is known as the static pressure at this point. The expression of a Westcott orifice meter or a Foxboro orifice meter is usually pictured in a person's mind just what you see by looking at the recording gauge. However, the recording gauge is only a part of the meter installation as it is necessary first to have a line with companion flanges and an orifice plate inserted between two flanges. Then by connecting the recording gauge to the line so that the pressures on the up and down stream sides of



Designed and Engineered by—
Jackson Engineering Corporation



Ventilation in even the slightest breeze

AT the first touch of the slightest breeze, the Burt Revolving Ventilator goes into action. Two sets of high grade bearings give it the freedom of movement necessary to point its open back directly into the flow of air.

Every bit of breeze is put to work! Some of it passes through the head of the ventilator and meets the exhausted air just as it leaves the air shaft, giving it the extra pull that has made the Burt open-back construction famous for its exhaustive power.

The remainder passes to the sides and above the flaring outlet where it creates a vacuum like effect and induces a continuous flow of vitiated air outward from the interior of the building. The flaring outlet also serves to hold the head steady in strong winds and prevent the whirling motion which destroys the effectiveness of revolving ventilators.

The Revolving Ventilator is only one of the complete line of Burt Ventilators—There's a size and type for every purpose—Detailed information or catalogs will be sent on request.

Burt Filters

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Ventilators-Oil Filters-Exhaust Heads

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Burt Exhaust Heads

the plate are placed on the meter properly you have an orifice meter installation.

The recording gauge is constructed with a U tube containing mercury and a float and the motion of this float is mechanically transmitted to a revolving chart, which indicates the drop in pressure across the orifice plate, recording it in inches of water pressure. It also has a helical tube element in combination, which records the static or line pressure at the point of the meter installation. If the meter setting is a flange connection the static pressure is taken from the down stream side of the plate. If the meter setting is a line connection the static pressure is taken from the up stream side of the plate. The chief reason for this is that the tests conducted in determining the coefficient for different size plates were run in this manner.

The orifice meters most commonly known are the Westcott and the Foxboro makes. The principle of the two is the same. Both are the mercury float type. Both manufacturers furnish meters with varying differential and static pressure ranges. The differential ranges are 2½-inch, 10-inch, 50-inch and 100-inch water pressure. The static element of course is interchangeable and can be had in ranges from 0-30-inch mercury vacuum and from 0-2000-pound pressure. In measuring casinghead gas under a vacuum the 10-inch or 20-inch range meters are usually used in order to obtain a very accurate reading with the least loss of pressure due to friction. In some refineries where the pressure is very low a 0-2½-inch of water differential is used. This meter is constructed with a large float and fuel oil instead of mercury is used as the liquid medium.

HOW TO INSTALL METERS

At city border stations where the flow varies considerably a combined or duplex installation consisting of a 100-inch meter and a 20-inch meter is installed in order to increase the capacity of the station and still get a very accurate measurement by reading the low differentials on the 20-inch meter. In reading a 20-inch range chart it is possible to read the differential to the nearest one-tenth inch, whereas on the 100-inch range it is practically impossible to read any closer than one-quarter of an inch.

In installing an orifice meter if it is to be a line connection the up stream tap should be two and one-half diameters of the pipe away from the face of the flange and the down stream tap should be made eight diameters away from the face of the flange. If this is a flange connection the taps are made one-inch from the face of the flange on both the up and the down stream connections. The different settings of course call for a different coefficient for the same size plate. For instance a coefficient for a four-inch line, a one-inch orifice plate, based on two-pound pressure base, .60 gravity, 60° temperature, 14.4-pound atmospheric pressure, is 237.50 for flange connections and 248.40 for line connections. It is recommended that an orifice plate greater than six-tenths of the size of the pipe should not be used.

In making meter connections the opening on the pipe or flange should always be free of burrs or welding material. The most satisfactory method of making these taps is to weld a collar on the pipe, provided this is a line connection installation, and drill an opening through the collar, using a sharp edge instrument for clearing away any burrs that the drill may have left. This opening should never be burned with a cutting torch.

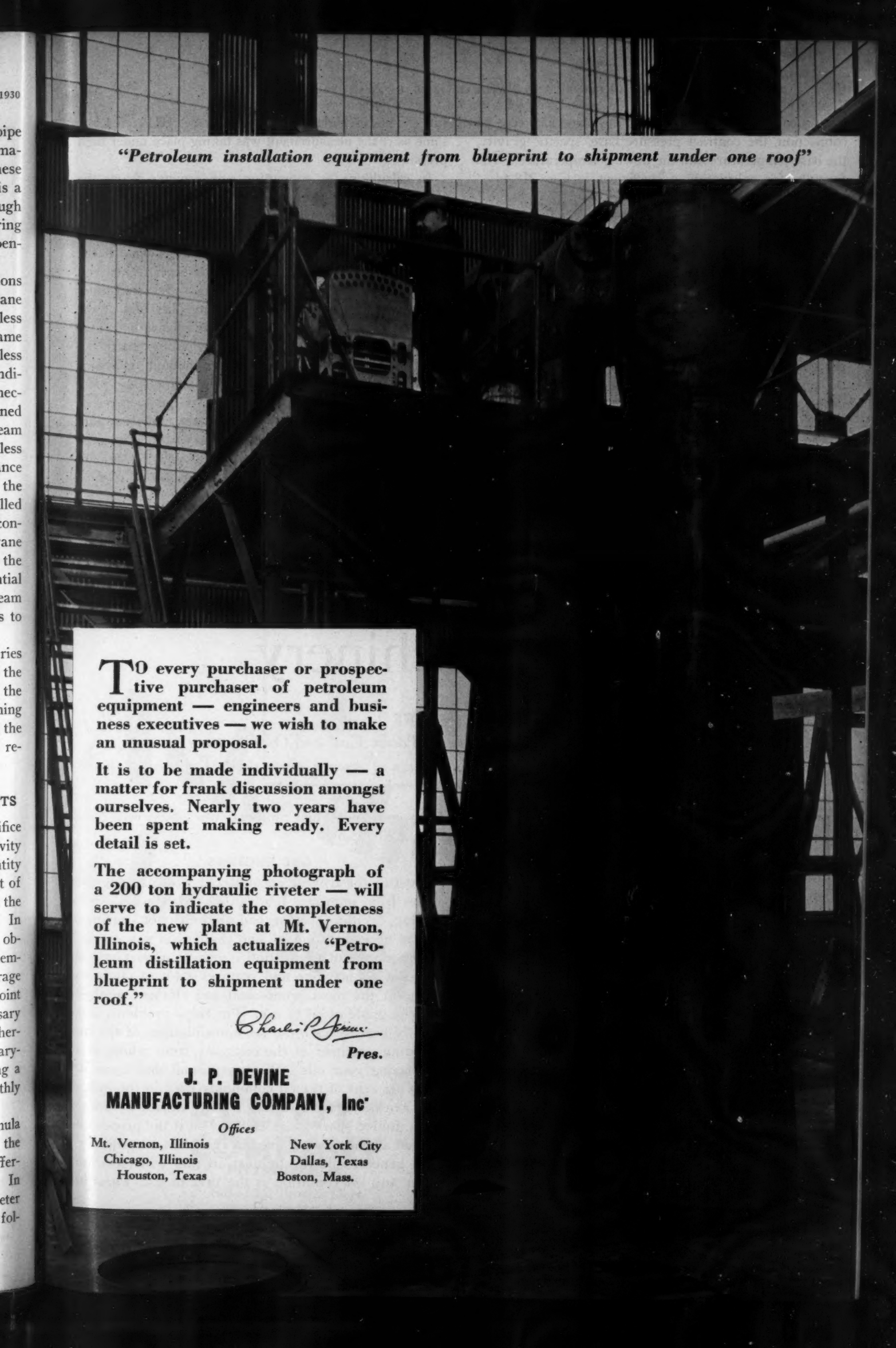
In installing an orifice meter with flange connections if the up stream fittings are two ells in the same plane the distance from the ell to the flange should not be less than 10 pipe diameters and with the conditions the same on the down stream side the distances should not be less than five pipe diameters. This also governs the condition where there is only one ell. If this is a line connection installation under the same conditions as mentioned above the distance from the point where the up stream meter connection is made to the ell should not be less than 10 pipe diameters and the down stream distance should be not less than five pipe diameters from the meter connection to the ell. If a regulator is installed within 200 pipe diameters up stream of the meter connections it is necessary to install a straightening vane not less than six pipe diameters up stream from the meter connection. A pressure regulator or differential valve or check valve should not be placed down stream from the orifice plate closer than 10 pipe diameters to the down stream pressure tap.

In measuring gas by orifice meters the quantity varies directly as to the square root of the differential and the square root of the absolute pressure. Therefore, as the differential increases with all other conditions remaining the same the volume increases. So is the case when the absolute pressure increases and all other conditions remain the same.

COMPUTING ORIFICE METER MEASUREMENTS

In order to obtain accurate measurement by an orifice meter it is very necessary to know the specific gravity and the flowing temperature of the gas as the quantity or the coefficient varies inversly as to the square root of the specific gravity and also varies inversly as to the square root of the absolute flowing temperature. In measuring gas from a well the gravity is usually obtained by tests made with a gravity balance and the temperature is usually assumed as 60° for an average throughout the year. If the measurement is at a point where the gravity and temperature vary it is necessary to install a recording gravitometer and a recording thermometer. The usual procedure for correcting for varying conditions is to compute a coefficient, assuming a gravity and flowing temperature and correct monthly for the actual temperature and gravity.

In computing orifice meter measurement the formula is $Q = C \times$ the square root of HP_s. Q equals the quantity, C equals the coefficient, H equals the differential pressure, P_s equals static pressure absolute. In calculating or even looking up a coefficient in the meter companies' hand books it is necessary to know the fol-



TO every purchaser or prospective purchaser of petroleum equipment — engineers and business executives — we wish to make an unusual proposal.

It is to be made individually — a matter for frank discussion amongst ourselves. Nearly two years have been spent making ready. Every detail is set.

The accompanying photograph of a 200 ton hydraulic riveter — will serve to indicate the completeness of the new plant at Mt. Vernon, Illinois, which actualizes "Petroleum distillation equipment from blueprint to shipment under one roof."

Charles P. Devine

Pres.

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lowing conditions: The line size, the plate size, type of connection, the contract pressure base, specific gravity, the base temperature and the flowing temperature. The formula for calculating a coefficient is $C = 218.44 \times Ed_s \times \frac{T_b}{P_b} \times$ the square root of $\frac{1}{T_f G}$. E equals efficiency of the orifice, d equals size of orifice, G equals specific gravity, P_b equals pressure base, T_b equals temperature base, T_f equals flowing temperature, 218.44 equals the constant and C equals the hourly coefficient.

In gasoline plant operation the measurement usually is under a vacuum condition and the same method of procedure is used with the exception of the record of the static pressure. The pressure is usually recorded in inches of mercury below atmospheric pressure. Therefore, in computing an extension it would be necessary to reduce the inches of mercury as registered by the static recording gauge to pounds per square inch and instead of adding to the atmospheric pressure this amount is deducted, which gives you the absolute pressure. The formula would be $Q = C \times HP_s$ just the same as if the measurement was taking place under high pressure.

In calculating or computing orifice meter charts the square root of the differential times the square root of the pressure as shown on the chart plus 14.4 times the coefficient for the plate that is installed at the point where this record was made, is equal to the quantity passed for a given period of time. When you have multiplied the square root of the differential times the square root of the static pressure plus 14.4 or the absolute pressure you have arrived at what is known as the extension. In most cases in computing charts the charts are read by the inspection method, which is simply placing a differential reading and a static pressure reading on the chart which shows the averages of both pressures for each hour. Hourly extensions are then placed on the chart and the total of the extensions is multiplied by the coefficient giving you the amount of gas that has passed this point for the period of time which the chart covers.

Care and Operation of Gasoline Plant Machinery

By D. B. HIATT

Superintendent of Gasoline Plants, Texas Pacific Coal and Oil Company

Before meeting of plant operators of the Natural Gasoline Association of America, Breckenridge, Texas, April 22, 1930

THE operation and care of mechanical equipment in a gasoline plant and its direct effect on continual and profitable production is one of the most important problems in plant operation. It often becomes such a matter of routine that many important features are overlooked. In addition to careful routine attention to all details incident to proper every day operation, the questions of maintenance, improvements, and changes to meet new conditions in the plant form a mass of individual problems which must be solved if your company is to receive a proper return on its investment.

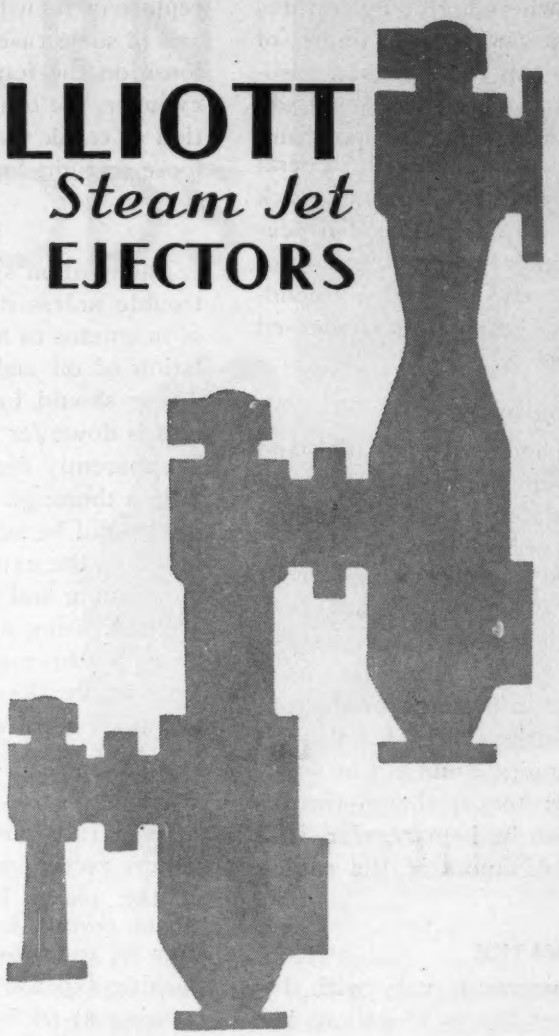
Most of the plants in this district are from five to 12 years old and were built with different ideas and conditions than those under which they are operated at the present time. I hope to cover the practical side of the operating problems with this in view. These ideas that I offer on this subject may not be new to you but if they suggest new angles in handling your individual problems my efforts will have been well repaid.

GAS ENGINES

Most of the trouble encountered with gas engines comes from improper lubrication, jacket scale, overloading, ignition system, bad alignment of bearings, lack of necessary repairs, and changes in gas supply.

The matter of lubrication is one of importance in any moving machine and requires a lot of study to arrive at the most economical and efficient method and the grade of oil to use. For these problems it is usually best to have the recommendations of the lubricating engineer of the company from whom you are buying your oils. We have found that from 20 to 50 per cent of the oil commonly used in the cylinders can be saved with less trouble caused by stuck rings, fouled spark plugs and carbon if the proper oil is used and the rate of feed is cut down accordingly. As a general rule the lightest oil that will lubricate under any set condition is the best to use. Paraffin

ELLIOTT
Steam Jet
EJECTORS



Ask the refiner who uses them

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base oils have higher flash and fire tests for the same viscosity than asphalt base oils and therefore stand up better in the cylinders or where high temperatures are encountered. There are a variety of examples of problems in choosing oils to suit conditions in gasoline plants: Extra heavy air compressor oil will add months of service to rings in high stage vapor compressors. Light lubricating oil mixed with mineral seal oil will cut out trouble with carbon and stuck valves on four cycle engines. Light unblended neutral will stop emulsion trouble in crank cases of steam engines where water is encountered. Unblended cylinder stock will separate better from condensed steam used as boiler feed water.

FUEL GAS SUPPLY

The gas supply should be well regulated and should be clean and free from moisture. The mixture must be carefully regulated to prevent carbon formation and loss of power. Much trouble is caused by worn regulator valves and loose governor connections causing irregular or choked gas feed. Sudden changes in the B.T.U. valve of the gas will make trouble in the engine room. A new absorber and still causing an increase in gasoline production cut down the B.T.U. valve on the residue gas to such an extent that a four cycle engine could not be started until it dawned on the operators to change the gas mixture. Unless the feed can be kept regular, it is not best to use uncondensed vapors in the engine room fuel on this account.

JACKET WATER

Jacket cooling water requirements vary with different inlet temperatures from five to 25 gallons per horse power hour. The outlet temperature should not exceed 140° Fahrenheit but you may have a low outlet temperature and a hot engine if the jackets are scaled. Whether you use gravity or force feed, enclosed or open cooling system, condensed water makeup, zeolite or other water treatments, are matters of individual preference so long as you keep a constant water supply and the jackets free from scale. The use of acids for cleaning jackets is necessary unless other means for preventing the formation of scale are installed. Jacket scale is the cause of nearly all trouble with cracked and scored cylinders, stuck rings, and loss of power.

INSPECTION

At least once a month each unit should be shut down for complete inspection and cleaning, paying particular attention to the need for small repairs. All bolts on moving parts should be replaced after two or three years' service. The crystallization of two bolts on the crosshead of a 70 H.P. engine cost over $500.00 in repairs in addition to damage to other units and the danger to the operator on tour.

REPAIRS

Whenever it is necessary to make repairs to engines which have been badly worn we have found it more economical to completely overhaul the engine, replace or rebush all work parts, realign the bearings and in some cases reset the engine completely if it is loose on the foundation. Except for trouble in the cylinder, the other two big problems are crystallization of crank shafts and connections and misaligned, loose or tight bearings.

IGNITION SYSTEM

The ignition system is the main cause of everyday trouble unless it is properly cared for. The failure of magnetos to fire is caused largely by the accumulation of oil and grit which shorts out the circuit. These should be thoroughly cleaned whenever the unit is down for inspection. Often a magneto which is apparently dead will give several months' service after a thorough cleaning. To prevent shorting, wiring should be kept supported away from the engine. Much of the expense of spark plugs can be stopped by cleaning and spacing the points at .015 inch. We are now using up oil plugs which had been thrown away, by this method. Be certain to use parts manufactured by the makers of your ignition equipment whenever repairs are necessary.

PUMPS

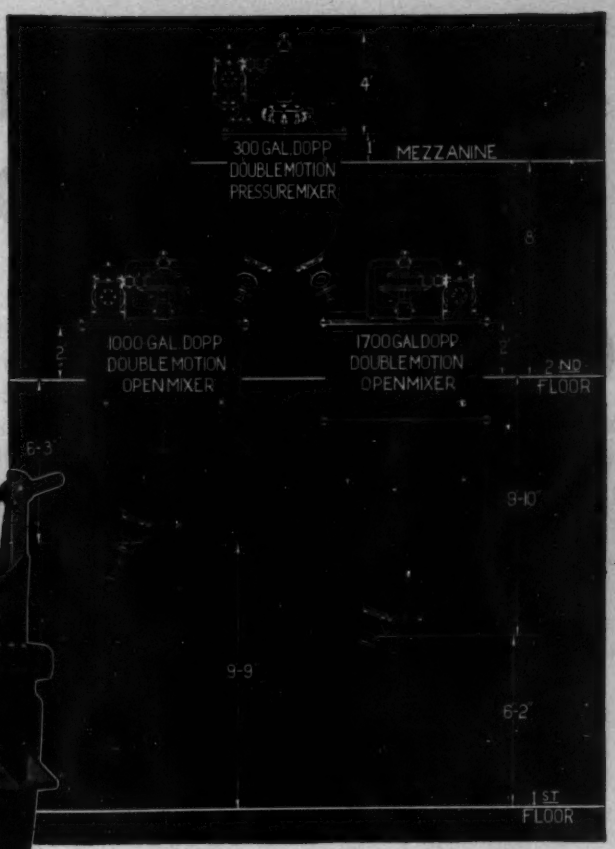
As a rule pumping equipment, especially steam pumps, receive more abuse than any other machinery in the plant. I would not recommend the use of steam pumps for any constant service with more than 50 to 75 foot piston speed. The repairs and packing expense were so large on a boiler feed pump running at 60 foot piston speed that we replaced it with an outside packed pump with capacity to run at only 20 foot piston speed. This pump had been used for over twenty years in mine boiler service. During the first year it was repacked only one time and had only one broken part during that time. It has been in service now for three additional years. Time will not permit discussion of packing for pumps and compressors, type and material of valves, and many other pumping problems, but the time spent in eliminating these troubles will pay good dividends in lowered operating cost.

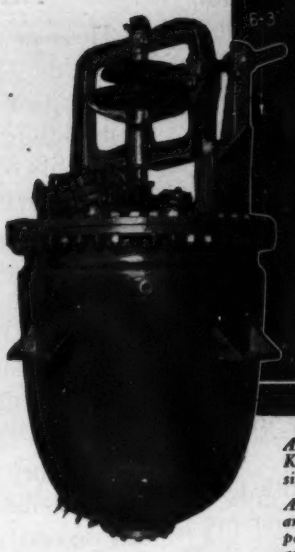
SUMMARY

In the care and operation of machinery the plant personnel is as much a factor as the kind, type, or age of the equipment. Like the boll weevil lubricator, there should be no place in this work for the soldier who does only as he is told, for the nervous soul who gets excited and jumps at conclusions, for the robot who goes about his tasks by mechanical set rules, for the hard head who will not change his mind in the face of proven facts, or anyone who will not apply ordinary common sense and physical laws to his everyday problems. When these have been eliminated, you will find a lowered operating expense and a higher efficiency rating.

MODERN METHODS

to Increase Grease Production





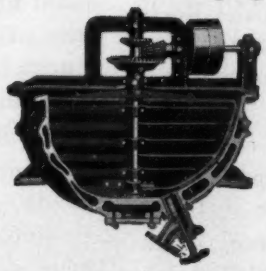
Above—A suggested arrangement of Pressure Mixer and Open Kettles for the manufacture of greases. Pressure mixers can be similarly installed to work with your present open kettles.

At Left—300-gallon Dopp "D" Double Motion Pressure Mixer, arranged for chain drive. Two sets of paddles revolving in opposite directions at different speeds give uniform saponification and the scrapers shorten time of heating, also cooling when desired.

MANY leading grease manufacturers who are using the pressure process for saponification have found that a relatively small investment in Dopp Mixers has enabled them to utilize their present grease making equipment to at least double its normal capacity.

By adding one Dopp pressure mixer of moderate size the capacity of a grease plant can be increased equivalent to adding several large open top mixers, yet at considerably less cost. Not only does the use of Dopp equipment result in increased output at much lower manufacturing cost but in many cases the product itself is materially improved.

The Dopp kettle insures efficient, uniform mixing under a pressure because the agitator is scientifically designed to accomplish this special purpose. Quick heating, also cooling when desired, are made possible because the inside of the kettle is scraped clean at each revolution—the smooth, seamless inside surface of the kettle and the spring scraping blades are responsible for this. The cast-in-one-piece construction prevents leaks because all seams, joints, welds, rivets and bolts are eliminated.



Cross section of Dopp Seamless Jacketed Kettle with "D" Double Motion Mixer, and outlet closing flush with inside.

The facilities of our completely equipped experimental department at Buffalo are available for the use of concerns desiring to investigate the possibilities of saponifying their bases under pressure or to determine data regarding processes and equipment. We invite inquiries from those who are interested in grease production.

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Gasoline Plant Construction Active During April

CONTINUED development of manufacturing facilities in refining and natural gasoline manufacture is indicated by a resume of the plant activities reported during the past month. This month, and for the first time this year, the natural gasoline plants reported are of more consequence than new refineries proposed or building. Two small refineries were announced and eight gasoline extraction plants.

A new refinery in the Panhandle region of Texas is under construction by Navajo Refining Company which will operate at 3000 barrels daily using Carson and Gray County crude. The second refinery is building at Collins, Teton County, Montana, with a capacity rating of 700 barrels daily. In Manchuria, Asia, South Manchuria Railway Company is reported to be operating its shale oil plant and producing about 1500 tons of oil per month, with plans to add units regularly until a capacity of 6000 tons monthly is reached.

Expansion of refining facilities continues with Gulf Refining Company nearing completion of its major program inaugurated several months ago, at its Port Arthur, Texas, plant. Eight Gulf type cracking units, two large Cross cracking units, two 14,000-barrel combination atmospheric-vacuum tube still units and a second 4000-barrel solution rerun unit are yet to be finished. Most of this work is slated for completion by June 1. Globe Oil & Refining Company is now operating its two Jenkins cracking units and its Winkler Koch unit at its Cushing plant, and has a 6000-barrel combination skimming-cracking Winkler Koch unit nearing completion at its Lemont, Illinois, refinery. The Taxman Company at Wichita Falls, Texas, has completed and is operating its Smith Engineering Company pressure coil type of unit. Empire Oil & Refining Company is adding a large number of steel storage tanks at its Ponca City plant. In Arkansas Lion Oil Refining Company is erecting a new 6000-barrel asphalt plant to produce various grades of asphalt from Smackover crude. Electrol Refining Company at Oklahoma City has stopped experimenting with its electric process and is operating as a skimming plant. Maple Leaf Refining Company at Coutts, Alberta, Canada, has resumed operations after a shut-down of several months. Stone Oil Company has taken over the refinery formerly operated by Terminal Oil & Refining Company at Texas City, Texas, and is producing gasoline, turpentine substitute, gas oil and bunker oil. Laurel Oil & Refining Company, Laurel, Montana, is to be placed in operation this month. Roosevelt Oil Company has purchased the Michigan Central Refining Company, and is moving the plant from Muskegon to the Mount Pleasant field of Central Michigan.

THREE NEW OKLAHOMA PLANTS

Three new natural gasoline plants are reported building in the Oklahoma territory. Carter Oil Company is adding two large plants in the Greater Seminole area and Phillips Petroleum Company has begun construction of its forty-sixth plant which is located in the north end of the Oklahoma City pool.

In Kansas the Empire Oil & Gas Company has completed construction of a new gasoline plant on the same site as the original Arkansas City plant, and the old equipment is now being reclaimed. Arkansas Natural Gas Company, in Louisiana, is erecting a natural gasoline plant in the Carterville area of Bossier Parish.

Phillips Petroleum Company is making gas contracts preparatory to the construction of a gasoline plant in the Judkins field, Ector County, Texas. This will be the second plant for this company in the West Texas sulphur gas district.

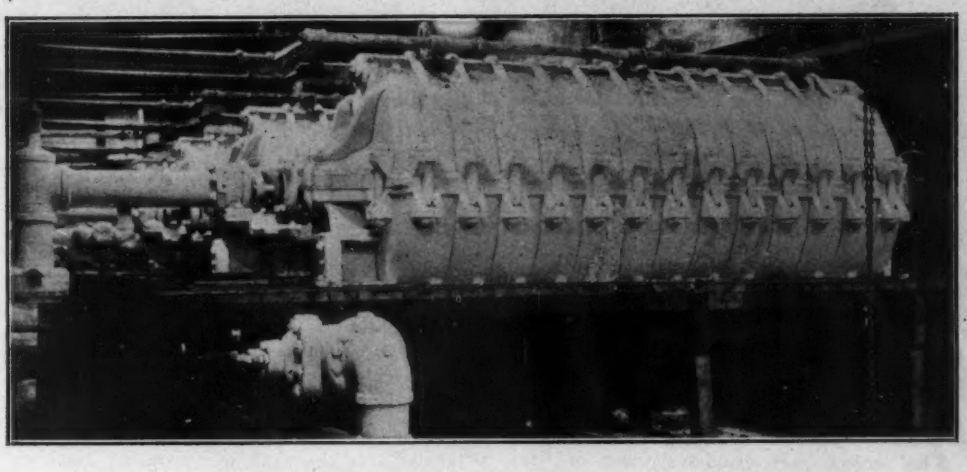
Texas Pacific Coal & Oil Company has announced that it will build a natural gasoline plant in southeastern New Mexico in the Hobbs area, which will be the first plant for this locality. The same Company is installing high pressure fractionation equipment at its plant near Caddo, Texas, preparatory to the manufacture of liquefied petroleum gas. In Canada, Research Engineering Company in conjunction with McLeod Oil Company plans to build a gasoline plant in the Turner Valley field.

Natural gasoline plants continue to be dismantled this month, especially in the older territories. Atlantic Oil Producing Company has abandoned two plants in Oklahoma and one in Gray County, Texas. Stebbins Oil Company is abandoning two plants and Gates Oil Company is dismantling one plant, all in Oklahoma. Oklahoma Natural Gas Company is also dismantling its last gasoline plant. The California Company at Westbrook, Texas, is reported to be planning abandonment of its gasoline plant there. East Ohio Company has shut down its charcoal type gasoline plant in Cuyahoga County, Ohio.

The new firm of Hanlon-Buchanan, Inc. has acquired all of the outstanding stock of Hanlon Gasoline Company and this company is no longer affiliated with Chestnut and Smith Corporation. The deal involved three natural gasoline plants in Texas and a stabilizing plant and terminal at Good Hope, Louisiana.

Vallez
ROTATING LEAF
FILTERS

for CONTACTING *and* DE-WAXING OILS



A battery of Vallez Filters in a large refinery

THE frost-covered Vallez-Filters shown above operate at 15 degrees below zero. The entire room is refrigerated. The Vallez works in a *closed system,* never being open during operation. All operations of the battery above are handled from a separate control room—illustrated below.

The Vallez operation of filtering is immediately followed by a washing with solvents. This washing is thorough because of the uniform thickness of cake, due to rotating leaf, and requires a minimum of solvent.

The solvent can be entirely steamed from the cake in the filter, if desired.

The capacity is large because of high filtration rate and minimum time for blowing and dumping.

Costly volatile solvents are used without appreciable loss, as the filters are never opened throughout the entire operating cycle. Although the gases from these solvents are extremely intoxicating, no gas masks are required, even in the filter room.

Control Room for above filters

Highest quality cold test lubricating oils are obtained, due to the close temperature control and brilliant Vallez filtrate.

Many Vallez filters are used successfully in contacting gasoline and cylinder oils; dewaxing of cylinder stock with diluents; doctor solutions; residuum; neutrals and distillates.

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TRADE NOTES *and* COMMENT

By GEORGE REID

"Elements of Fractional Distillation," by Clark Shove Robinson, associate professor of Chemical Engineering, Massachusetts Institute of Technology, which was originally published in 1922, has been revised and a second edition published as of January, 1930.

Professor Robinson's discussion of the principles of distillation and fractionation as originally published eight years ago, constituted one of the most readable presentations of the principles involved. It was the author's purpose to explain simply, yet accurately, according to the best ideas of physical chemistry and chemical engineering, the principles of distillation and fractionation, accompanying the discussion with many well-selected illustrations.

In general, the second edition follows the plan of the first in that it has been divided into five parts. The first part deals with fractional distillation from the qualitative standpoint of the phase rule. The second part discusses some of the quantitative aspects from the standpoint of the chemical engineer. Part three discusses the factors involved in the design of fractional distilling equipment. Part four gives a few examples of modern apparatus covering such matters as simple distillation of complex mixtures, topping stills for crude petroleum, and the like. There are in this second edition five additional chapters not included in the first edition. The last portion of the book includes a number of useful reference tables which have been compiled from sources mostly out of point and unavailable except in large libraries.

In his preface to the second edition Professor Robinson says: "Since the first edition of this book was printed in 1922, the tremendous growth of the petroleum industry has focused the attention of engineers on the problems incident to the design of equipment for petroleum refining, notably in regard to the improvements in petroleum distillation practice. In preparing this edition, therefore, I have taken opportunity to include a certain amount of material directly applicable to that industry. This includes the recent work of W. K. Lewis and his associates on the vaporization and rectification of complex hydrocarbon mixtures, natural gasoline, and petroleum, McAdams' study of the weathering of natural gasoline, Carey's and Smoley's studies of the efficiencies of rectifying columns; and other material of a similar character—all of which it is believed will be of greatest assistance to the designers of distilling equipment. I have tried to retain in this new material the elementary character of the earlier edition."

It is interesting to note that in the author's chapters on fractionation, simple distillation, and continuous distillation, and similar subjects ably handled in the first 20 chapters of this second edition, it was possible to use the same diagramatic illustrations as were published in 1922. These diagrams not only fit nicely with latest modern construction practice, but indicate that in the "dark days" of the hollow columns the principles and designing practice of modern work was freely available to technical students of the industry.

This book can not be regarded as a complete treatise nor an encyclopedia on the subject of fractional distillation, but as the title indicates, it is an introduction to the subject. The material is clearly presented, and the work will prove of real value to those interested in design and operation of distilling and fractionating equipment. The book should be on every superintendent's, engineer's, physicist's, and chemist's book-shelf, handily placed for ready reference.

"Elements of Fractional Distillation" can be secured from The Gulf Publishing Company, Price $3.00.

* * *

Probably the most positive evidence of the value of technology to the refining industry is found in the rapid development of fractional distillation equipment and practice since about 1924.

Likewise there is positive evidence that the former unwillingness to apply scientific data to the practical problems of refining was excessively costly to the industry.

And further, one of the "jokes on the industry," or at least the greater part of the industry, was the mysterious manner with which many refineries proceeded with the development of their fractionating equipment. Bubble towers were secretly designed and fabricated in buildings often closed to process workmen on the same plant during the years 1923-24. In fact, from the writers personal notes record is taken of 33 Mid-Continent refiners visited, 22 of which were secretly building or had just placed in service, bubble type fractionating columns which for the most part were badly designed, and many of which were later dismantled because "they wouldn't work." Only recently a refiner was willing to discuss mechanical and operation details of similar equipment because he supposed that "bubble towers were no longer secrets."

During the years that bubble towers "wouldn't work" and in fact, three years before their general acceptance by an industry which had finally learned something of calculating capacities, all of the fundamental information necessary for accuracy was available and in book form, presented in such a manner that even untrained or non-technical men could have avoided making the scores of serious and costly errors which were made. This is one of the prices of secrecy.

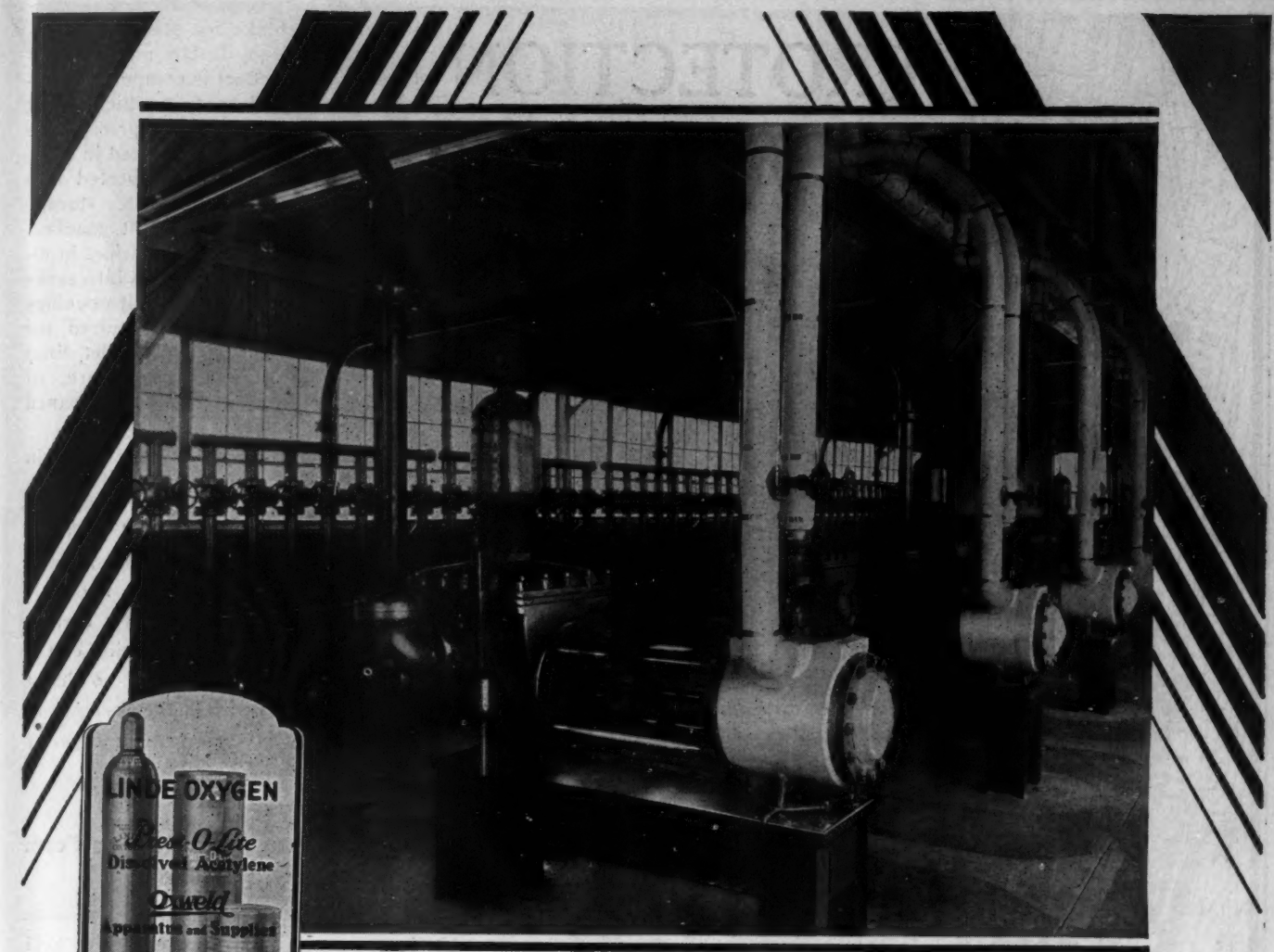
Robinson, in 1922, in "Elements of Fractional Distillation," presented this material, for example, and other workers contributed similarly valuable information. But limited use was made of it.

Something of the value of Robinson's early discussion of the principles of Fractional Distillation is indicated by the fact that in his recent revision of his book Professor Robinson had but little changes to make in his original text, for the same fundamentals govern now as did eight years ago. And further, his detailed discussion of bubble tower fabrication and method of calculation for capacity and the like, needed little revision. In addition his diagrams of fractionating columns, natural gasoline stills, continuous stills, intermittent stills, continuous still for three components, and the like, as published in his original book in 1922, are the same illustrations in his book of 1930—and they are just as applicable to modern design and practice. Yet design of bubble caps, spacing of trays, methods of refluxing, points of entry for reflux media, methods of removal of side streams, and so forth, were all highly secret practices in 1923-24.

Now it appears to the writer that what started out to be "comment" having to do with a joke on the industry because of its secretiveness when there are few, if any, secrets, has became a preachment—which is a good place to stop.

In July, 1929, Continental Oil Company at Ponca City, Oklahoma, shut down its old Flemming cracking units after their last run. With the removal of these 18 units from the picture but three Flemming units were left. January 1, 1928, saw the listing of 31 units of this type. Lubrite Refining Corporation at East St. Louis has the three remaining units. Pennzoil at Oil City, Pennsylvania, dismantled its units about a year ago.

Continental at Ponca City has con-



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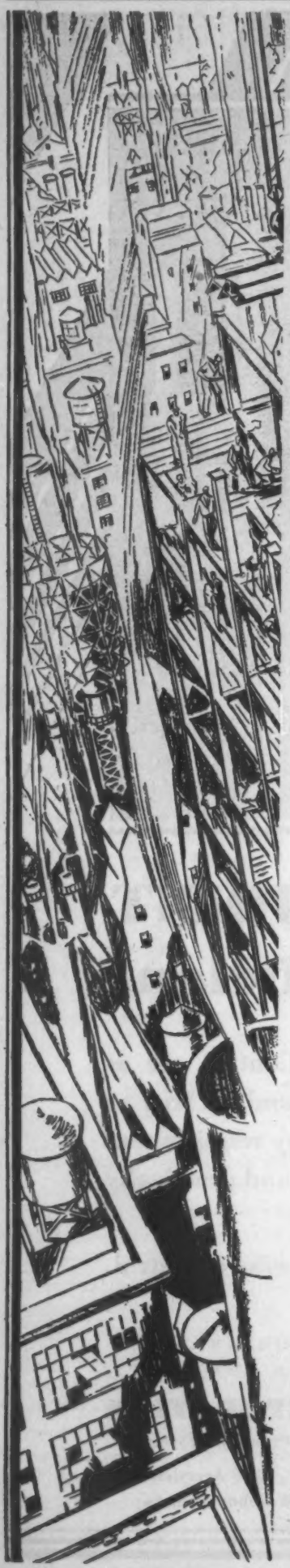

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verted its battery of 18 Flemming stills into storage tanks for stabilized gasoline derived from Dubbs pressure distillate. The product is composed mostly of butane and pentane which is not of sufficiently high vapor pressure to become hazardous when stored in these old pressure vessels. Converted into the tanks the battery provides storage for 7200 barrels of this light gasoline. The shells are 10 feet by 30 feet in dimensions and the conversion into tanks consists merely of closing all openings except those which are required for pressure relief, inlet and outlet lines and the like. The vessels, are, of course, thoroughly scraped and cleaned and freshly painted.

These stills went into operation in October, 1922, and between that date and July, 1929, a total of 8,871,188 barrels of gas oil was charged to them and they produced a total of 4,581,683 barrels of pressure distillate, and during this time no accidents of a serious nature occurred in the operation of the battery. The old stills will no doubt give many years of further service to the company in their present capacity of storage tanks.

Arkansas-Louisiana Refiners Form Organization

Refiners of Arkansas and Louisiana have formed an association, which held its first annual meeting in El Dorado, Arkansas, early in April. T. M. Martin, vice-president of Lion Oil Refining Company, was chosen president. Vice presidents are W. E. Winship, president of Chalmette Petroleum Corporation, New Orleans, and J. B. Atkins, vice-president of Shreveport-El Dorado Pipe Line Company. J. F. Atkins, secretary of Shreveport-El Dorado Pipe Line Company, Shreveport, is treasurer, and Leon Gorsjean is secretary.

Tulsa Exposition Plans

Plans have been completed for seggregating displays of the refining and the marketing divisions of the industry for the next International Petroleum Exposition and Congress, which will be held October 4 to 11. A new building is being erected for this part of the exposition. A committee of executives whose interests are centered in refining and marketing, is now at work to select a program and other activities to bring this phase of the exposition up to a standard set for the producing division.

Cameron Pumps

An unusual and highly successful pumping unit! It is now being used for absorption oil service in a large natural gasoline plant on the west coast.

A single turbine drives three Cameron Pumps of different sizes, types, and characteristics. On the first line, a Cameron No. 6 "NFV" Pump handles water at the rate of 1400 g. p. m. against a total head of 65 feet; on the second, a No. 3 "HV" Pump moves lean oil at 400 g. p. m. against 336 feet head; while on the third line, fat oil is pumped by a No. 3 "NFV" with a capacity of 425 g. p. m. against a total head of 196 feet.

Cameron engineers are thoroughly familiar with every conceivable liquid handling problem, and their experience and ability are reflected in the great number of successful and diversified installations in the oil industry.

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P. E. Foster, superintendent (at extreme right end of back row) and the supervisory force of the Shell Petroleum Corporation's Norco Refinery at Sellers, Louisiana, which, in co-operation with the refinery personnel, recently finished over a million and a quarter hours of work time with no lost-time accident

Over a Million Hours With No Lost-Time Accident At Shell Petroleum Corporation Refinery

As a result of the intense efforts and good work of its entire personnel in promoting the nation-wide safety movement among its employees as sponsored by the National Safety Council, the Norco refinery, of the Shell Petroleum Corporation, Sellers, Louisiana, has broken the world's safety record for the refining branch of the industry according to an official report received at the headquarters of the corporation in St. Louis.

This record covers the aproximate five month- period ending March 31. Up to and including April 23, the Shell Petroleum Corporation's Norco refinery employees had worked 179 days with a total of 1,479,700 hours without an accident serious enough to cause a loss of time. This figure exceeds the former world's safety record for oil refineries by 158,000 hours and puts the refinery in an advantageous position to win the safety record for all industries, or 2,000,000 hours, the high mark which the safety organization at the Norco refinery has set as its goal.

The safety program at the Norco refinery, which has the sanction and full cooperation of the National Safety council, is conducted under the supervision of the central safety committee of the refinery, which in turn is made up of the foremen's and the working men's safety committees. The central committee which functions as the governing body in all safety activities is of and for both department heads and employees. To this committee and no less to the hundreds of individuals who cooperate daily and hourly with it, belongs the credit for the world's safety record for oil refineries. Foremen in each of the departments of the refinery serve regularly on the foremen's committee while workmen in the various departments are chosen to serve short terms of one to two months in order to give all an opportunity to take a personal part in the safety program and to keep interest up to a high point of enthusiasm.

In commenting upon the nation-wide safety movement and the safety records made by the Norco refinery at Sellers, Louisiana, P. E. Foster, superintendent of the refinery, said:

"Aside from the high purpose of the nation-wide safety movement sponsored by the National Safety ouncil and entered into by an ever-growing number of large industrial organizations and its all-important chief objective which is first of all the protection of life and limb, this movement is of especial significance to employer and employee alike in that it draws them close together into a kind 'brotherhood for safety,' the tenets of which are based upon the very human principle of life-saving through adequate measures designed to prevent and remove wherever possible the cause of accidents. The safety program of the Shell Norco refinery which has recently broken the world's safety record, an accomplishment of which we are all justly proud, is a cooperative movement among employees, foremen, department heads and executives all of whom are imbued and inspired with the spirit of conserving human life and limb, increasing the efficiency of the workers and thus adding to their peace of mind and to the prosperity and happiness of the entire organization and those directly and indirectly connected with it."

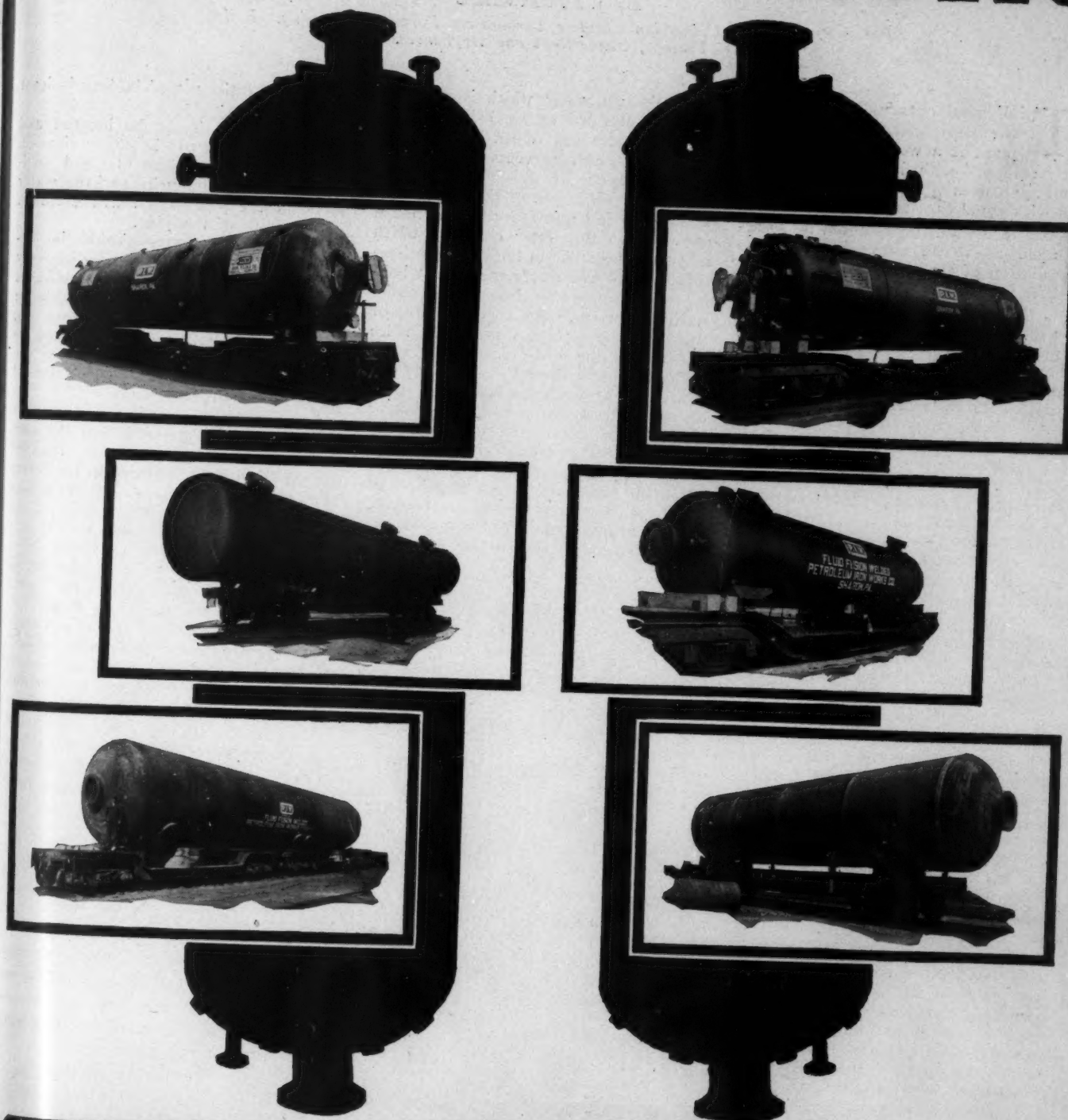
Production and Uses of Petroleum Coke Covered

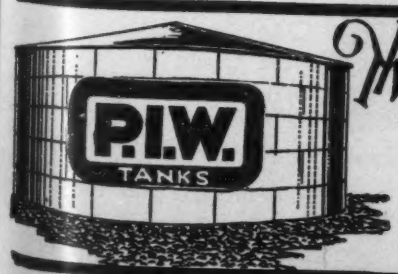
E. B. Swanson, Economic Analyst, U. S. Bureau of Mines, has completed a valuable and interesting economic survey of the production and uses of petroleum coke. This paper, which was completed by its author in December, 1929, is now available from the Superintendent of Documents, Washington, D. C., price 10 cents. The order number is Economic Paper No. 9, "Petroleum Coke." The paper is a study of the production of petroleum coke by coking and cracking methods, a statistical report of consumption and production, a directory of uses of the product by a large number of industries for a great many purposes, a report of consumption of the product as fuel in refineries and industrial enterprises, and a report of exports. Mr. Swanson has gone into his subject very thoroughly and presented his findings in both a concise and interesting manner.

This is the first time that the subject of petroleum coke has been dealt with in any manner at all authoritatively or in any manner broad enough in scope to be of value to the manufacturing industry. His work brings to attention some very interesting facts regarding the consumption of coke by the refining industry as well as its utilization by a number of other industries. Economic Paper No. 9 is a complete and comprehensive study of the petroleum coke situation. It is hoped that the Bureau will undertake several more surveys of its type dealing with other products and by-products of the refining industry, for such analyses are of great value to manufacturers of such products.

Incidentally, Universal Oil Products has reprinted in booklet form late articles appearing in the trade press dealing with the consumption of petroleum coke as fuel by refineries including "Petroleum Coke and its Utilization" as published in The Refiner and Natural Gasoline Manufacturer, January, 1930, and "Pressure Still Coke Burners Save Refiners $12,000 Per Year," National Petroleum News, Feb. 19, 1930, and "Petroleum Coke—Its Utilization As Boiler Fuel" as published in Power Plant Engineering, March 1, 1930. These are available from Universal Oil Products Company, 310 South Michigan avenue, Chicago, or copies may be secured from the publishers.

MONUMENTS · OF · SAFETY · IN · · FLUID-FUSION · WELDED · · · CRACKING · VESSELS





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Boiler Fittings, Connections and Appliances

By J. P. SAVELL

Paper Presented at Columbian Gasoline Corporation Foreman's Meeting. Boiler Fittings, Connections and Appliances.

THE most outstanding feature in the ideal operation of a steam plant is a well set boiler properly equipped with fittings, connections and appliances which have been selected with equal care and good judgment.

The feed water pipe should be so arranged as to be convenient for the regulation of the feed water.

The main feed piping may be of iron but the branches to the boiler should be of brass since brass is less affected by corrosive agents in the feed water than is iron pipe, and there is less tendency for scale forming impurities to cling to its surfaces.

All elbows, tees and flanged unions used on the feed line should be of extra heavy cast iron.

If there is a fitting between the stop valve and the boiler it should be of extra heavy brass as it is possible for water hammer to develop from some unforeseen cause while the boiler is in line, and a cast iron fitting might break under the strain. It is better to use long radius bends when possible instead of short right angle fittings.

The feed water control is an apparatus that is much to be admired by all concerned. It is an endless source of help, assurance, contentment and satisfaction to the operator and it should be respected, cared for, and considered as one of the boys at the plant, and it can be relied upon in proportion to the care it gets. It should be separated from the boiler with a valve so that it can be repaired while the boiler is in operation. Its functions is to control the flow of feed water to the boiler, thus preventing accidents on account of high or low water, it prevents the stresses and strains that would otherwise be present from contraction, due to the injection of large quantities of cold water into the boiler for the same reason it advances the effectiveness of feed water heating apparatus and enables the boiler to deliver a constant flow of dry steam that could not be expected with the injector.

A dry pipe, is a slotted or perforated pipe or apparatus connected to the inside of the steam outlet, and its functions is to obstruct water which is entrained with the liberated stream bubbles in the outgoing steam and return it to the water space, which prevents priming. It would be better if the dry pipe would extend the full length of the shell. This would provide ample space for the return of water to the water chamber, which might be impossible in the case of a box-shaped apparatus where the violent boiling of water directly beneath the outlet nozzle is present. The combined area of any dry pipe apparatus should be twice the area of the outlet nozzle.

Feed water should never be discharged near a riveted joint or furnace sheet, as feed water is always cooler than boiler water, the comparatively cool feed water would chill and contract the plate or seam upon which it might be permitted to discharge. This local contraction would cause straining there of the metal. Feed water should be discharged in the part of the water space where the act of boiling is least violent.

Feed piping should be located and jointed so that it can be easily cleaned, as scale forming elements and sediments from the impurities of the water settle in the pipe which will diminish the capacity of the pipe.

Water gage glasses should be enclosed in a protector made of very tough plate glass for this purpose. This will give protection to the man in charge when the gage glass blows out.

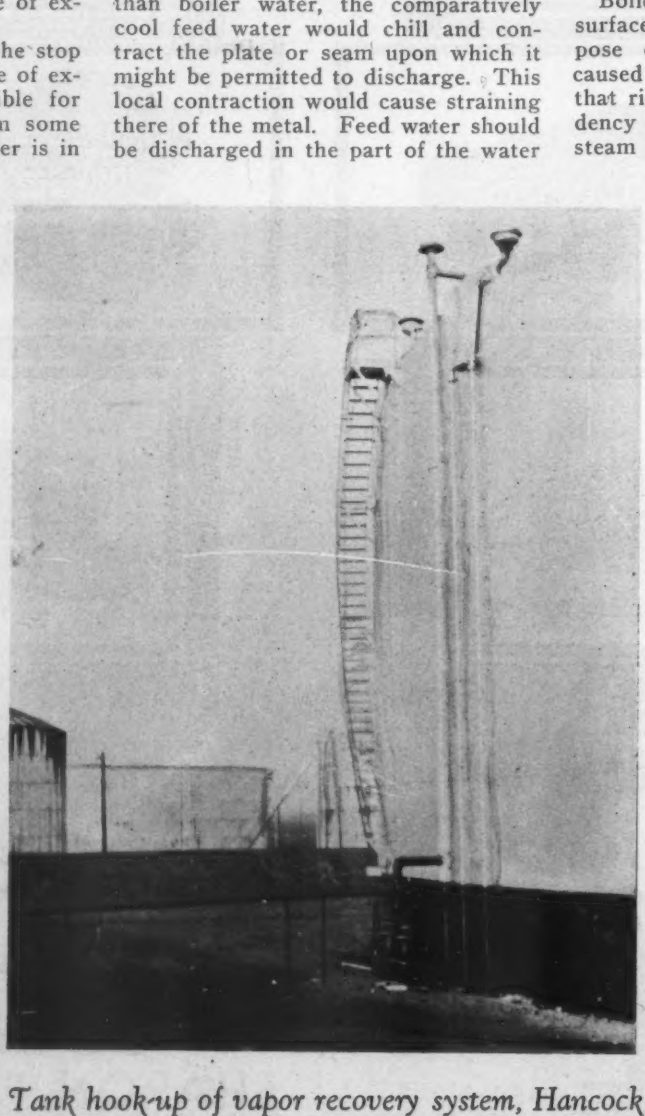
Boiler blow-off apparatus should be so connected that a part or all of the contents of the boiler can be released at the will of the operator.

Boilers should be equipped with a surface blow-off apparatus for the purpose of blowing off scum that is caused from the impurities in the water that rise to the surface. It has a tendency to hinder the free escape of the steam bubbles which cause violent agitation of the water that often results in priming, the act of which may carry the scum through the main steam line and on to the engine and other equipment and cause scoring of valves, cylinders, pistons and poor lubrication. Surface blow-off piping should not exceed one and one-fourth inches in diameter and should form a continuous passage which can be accomplished with bushing made for this special purpose.

The bottom blow-off apparatus is for the purpose of blowing off the sludgy sediments that collect in the bottom of the boiler or mud-drum and for lowering the water level in case of priming and for emptying the boiler for cleaning.

The bottom blow-off piping should not be less than one inch nor more than two and one-half inches in diameter and should be placed at the lowest water space of the boiler.

Fittings between the boiler and blow-off valve should be of brass or low carbon steel. Cast iron is not safe for blow-off fittings.



Tank hook-up of vapor recovery system, Hancock Oil Company, Long Beach, California

REFINERY AND GASOLINE PLANT ACTIVITIES

New Plants – Construction Notes – Personnel Changes

Erecting Natural Gasoline Plant

Arkansas Natural Gas Corporation, a Cities Service subsidiary, is erecting a natural gasoline extraction plant in the Cartersville oil and gas field of Bossier Parish, Louisiana, 40 miles northeast of Shreveport. The plant has a rated capacity of 10,000 to 15,000 gallons daily. A Southwestern type 220 absorption plant is being installed, and the compressor station is equipped with type 85 Cooper-Bessemer machines. The plant is located on the Kilgore farm in Section 31-23-11 and should be in operation late in May. E. P. Farmer is in charge of construction under the direction of K. D. Jones, superintendent of the gasoline department for Arkansas Natural Gas Corporation.

Atlantic Dismantles Gasoline Plants

Atlantic Oil Producing Company has shut down its gasoline plant and has dismantled most of the equipment. Two plants in Oklahoma were abandoned, one being located on the north half se, Section 36-12n-10e. The other was in Section 16-14n-10e in Creek County. Combined rated capacity of 5000 gallons.

In the Texas Panhandle, Gray County, nw Section 83, block 3, I. & G. N. R. R. Survey, the company abandoned a 10,000-gallon plant. Gas formerly treated by these plants has been disposed of to other operators.

Bureau of Mines Studying Liquefied Gas

United States Bureau of Mines has made arrangements for a survey of the conditions attending the marketing of liquefied petroleum gas. This analysis is to include surveys of sales and distribution to domestic and industrial consumers over a period of years and of industrial uses for which this product is now being distributed. This work is being done in response to a number of requests received for specific information relative the use of such gas. The survey will be made by the economics division of the bureau.

Shut Down West Texas Plant

The California Company shut down its combination compression and absorption gasoline plant five miles north of Westbrook, Texas, in the West Texas area in January and has not resumed operations. The plant has a capacity of 3500 gallons daily. The California Company is a subsidiary of The Standard Oil Company of California.

Carter Building Two Gasoline Plants

Carter Oil Company is adding two new natural gasoline plants in the Greater Seminole area of Oklahoma. One is located in the comparatively new field known as East Earlsboro, and will have a rated capacity of 60,000 gallons per day. The second plant under construction in the Bowlegs pool will have a rated capacity of 25,000 gallons daily. Both plants are employing Braun equipment.

Central Texas Refinery Under Receivership

Central Texas Refining Company was placed in receivership April 18, through court action taken in Corsicana, Texas. R. L. Wheelock, oil operator and mayor of Corsicana has been appointed receiver and has announced that operations will continue as heretofore. Controlling stock interest of the company is owned by Cranfill-Reynolds Company, which in turn is controlled by the Moody-Seagraves interests. Refineries are located at Brownwood, Luling, Minerva and Angus, Texas.

Electrol Operating Atwood Plant

Electrol Refining Company has started operating the Atwood refinery at Oklahoma City which was taken over by the company last year. The company has been experimenting with and electric process for refining oil. At present, however, shell still equipment is being used in skimming plant operations charging oil from the Oklahoma City field.

Crude is delivered by pipe line by Indian Territory Illuminating Oil Company, and present rate of charging is 1000 to 1200 barrels daily. D. L. McCabe is general manager of the company. Carl B. Ray is plant superintendent. General offices are at the plant at 2216 West Ash St., Oklahoma City.

Empire Adding Tanks at Ponca City

Empire Oil & Refining Company at Ponca City has been adding steel storage tanks at its refinery there. These consist of two 118,000-barrel tanks for crude storage, two 37,500 barrel, and two 25,000-barrel tanks which are added to facilitate operations. Steel has been purchased for 25 to 30 miscellaneous run-down tanks of about 2500 barrels capacity. R. R. Mills is superintendent of the refinery.

Empire Completes New Kansas Plant

Empire Gas & Fuel Company has completed the installation of its new absorption natural gasoline plant at Arkansas City, Kansas, and has placed this equipment in operation. Work on the new plant facilities started January 1, 1930. The new plant was erected beside the older installation which has been in service for about 12 years, and the switch from old equipment to the new plant was made with operations suspended but one day.

The new plant has a rated capacity of around 12,000 gallons daily and can handle 40,000,000 cubic feet of gas. The plant is located about a mile north of Arkansas City on the Winfield road. Practically all of the plant production will be utilized in the blending operations by the refineries at Arkansas City. Bill Yingling, who has been in charge of operations since 1918 will continue in the capacity of superintendent.

Hungerford Joins Derby Staff

Derby Oil Company, Wichita, Kansas, has announced that A. B. Hungerford, formerly plant engineer for White Eagle Oil Corporation, at its Augusta, Kansas, refinery has joined the staff of the Derby organization as chief engineer, beginning his duties May 1.

Ohio Charcoal Plant Shut Down

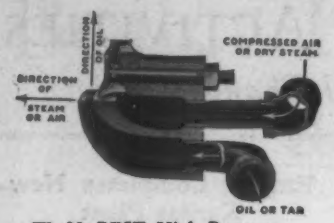
East Ohio Company has shut down its natural gasoline plant of the charcoal type on the W. Bartlet farm one and a half miles southeast of Berea in Cuyahoga County, Ohio. The plant was one of the few charcoal type plants in the eastern fields and had a rated capacity of 1000 gallons daily.

Enlarges Cushing Plant

Globe Oil & Refining Company has completed construction and started operating its two Jenkins cracking units at its Cushing, Oklahoma plant. This plant is also equipped with a combination skimming and cracking unit of Winkler & Koch type. Work on the new 6000 barrel capacity combination skimming and cracking unit at the Lemont, Illinois plant is well under way and construction should be completed in June. This installation is also of Winkler-Koch type.

Gulf Completing Expansion Program

Gulf Refining Company, at its Port Arthur, Texas, refinery plans the completion of its major enlargement program begun last year about June 1. Completion of this work marks the conclusion of one of the most ambitious enlargement and expansion pro-



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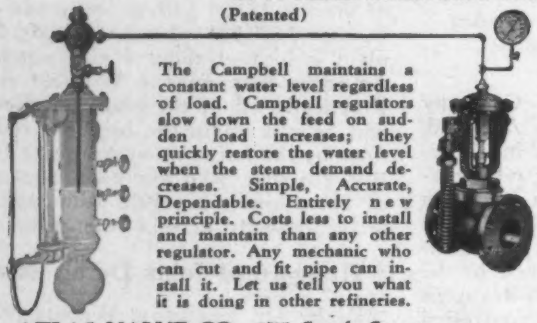

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gram ever undertaken on any single refinery yard in the history of the industry. With the expansion of distillation, coking and cracking facilities it became necessary to effect similar enlargement of practically all of the manufacturing departments of the plant.

Four of the 3000-barrel Cross cracking units have been completed and placed in operation and the remaining two units of similar capacity are to be completed this month. Sixteen of the Gulf type cracking units were included in the program, all of which are equipped with DeFlorez type of furnaces. Eight of these have been completed, with the remaining eight due for completion in the near future. These units are rated between 2000 and 3000 barrels capacity each. To provide sufficient gas oil charging stock for the enlarged cracking department 24 new 1000-barrel coking stills have been installed. The Bureau of Mines survey of cracking units for January 1, 1929, reports 70 cracking units operating at Port Arthur with a total capacity of 39,700 barrels, and 11 units with a total of 7700 barrels capacity shut down. The 16 Gulf type and six Cross units bring the total number to 82 units and the total cracking capacity to about 90,000 barrels daily. In addition there is a total of 17,000 barrels cracking capacity at the four other Gulf plants.

Five Badger pipe stills with rated capacity of 6000 barrels each have been completed for use in the redistillation of pressure distillate.

Two 14,000 barrel combination atmospheric - vacuum Foster - Wheeler tube stills are under construction for processing Mid-Continent crude, and these should be completed early in June. Two combination atmospheric-vacuum units of Badger type were recently completed with a capacity rating of 6000 barrels each, which are employed in the distillation of coastal crudes. These four installations are utilized in the preparation of lubes and gasoline from the crudes mentioned. A second Smith Engineering solution rerunning installation is to be installed which is a duplicate of the 4000-barrel unit of the same type installed last year. With the increased facilities for preparation of lubricating oils it became necessary to enlarge the Sharples centrifugal dewaxing plant from 36 centrifuges to 86 of these machines. Direct expansion coolers have been installed to secure the lower temperatures required for the preparation of low cold test lubricants.

Through the installation of this new equipment the total capacity of the Gulf Refining Company's plants is increased to a possible 250,000 barrel daily. This indicates that the Port Arthur plant capacity may be raised from its present rated capacity of 125,000 barrels to about 175,000 barrels daily.

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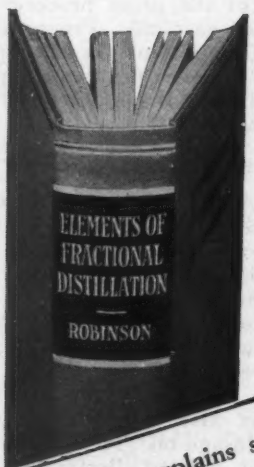

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Clark Shove Robinson
Assistant Professor of Chemical Engineering, Massachusetts' Institute of Technology

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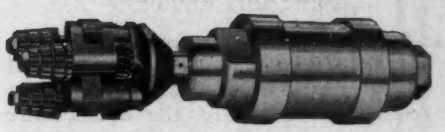

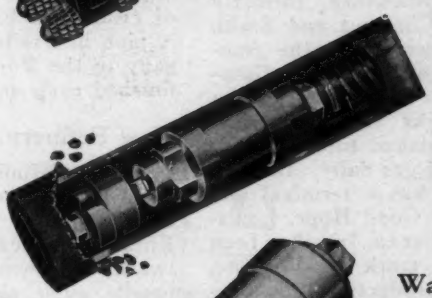

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Oklahoma City Refinery Changes Hands

Gulf States Petroleum Company is reported to have taken over the properties of Caravan Oil & Refining Company, Oklahoma City, recently when Victor H. Smith of Gulf States Terminal & Transport Company purchased the properties of the Oklahoma City organization. Gulf States Petroleum Company is but newly organized to handle the manufacturing enterprises of the parent company.

Hanlon-Buchanan Buys Hanlon Gasoline Company

Hanlon Gasoline Company is no longer affiliated with Chestnut and Smith group of companies since the acquisition of all of the outstanding capital stock of Hanlon Gasoline Company by E. I. Hanlon and associates of Tulsa. The properties in the future will be operated by Hanlon and his associates who organized the Hanlon-Buchanan, Inc., last year to engage in the manufacture and sale of natural gasoline. D. E. Buchanan, formerly vice president of Chestnut and Smith Corporation is president of the company. Gasoline plants of Hanlon Gasoline Company are in operation at Breckenridge, Parks and Eliasville, Texas, with a combined total capacity of 60,000,000 feet of gas daily. In addition the company has a terminal and stabilizing plant at Good Hope, Louisiana. Hanlon-Buchanan, Inc., has been granted the trade mark Sta-Vol-Ene, under which their products will be marketed in the future.

Laurel Plant to Operate Early in May

Laurel Oil & Refining Company, Laurel, Montana, is rapidly nearing completion and it is planned to place the equipment in operation early in May. Smith Engineering Company has been pushing the work to completion. The plant has been receiving crude oil in storage at the rate of about 1000 barrels daily.

Lion Oil Building New Gasoline Plant

Lion Oil Refining Company, El Dorado, Arkansas is erecting a new 6000-barrel asphalt plant to produce various grades of asphalt from Smackover crude. This will increase the capacity of the company's refinery to 21,000 barrels daily. The new asphalt plant will operate under the vacuum method of distillation which results in lower distillation costs. Recovery of 30 per cent of paving asphalt of 30-40 penetration and 100 centimenter ductility is contemplated. The installation is to be in operation by June 1 to take advantage of this years paving season requirements.

New Type Charging Pumps Installed

Louisiana Oil Refining Corporation has installed new type condensing turbine driven centrifugal charging pumps for use in operating its tube and tank cracking units in place of the non-condensing reciprocating pumps formerly used, at its refinery near Shreveport, Louisiana.

The new pumping unit consists of a steam turbine with 328 to 400 horsepower range when operating under a vacuum of 27 inches. The turbines are directly connected to certrifugal pumps with a capacity of 125 to 225 gallons per minute at operating pressures respectively 1200 pounds and 800 pounds. Guaranteed efficiency is 48 per cent, and the water rate on the turbines is 15½ pounds water per horsepower. The new equipment is reported to effect a saving in investment and operating costs.

Maple Leaf Refinery Operating

Maple Leaf Refining Company at Coutts, Alberta, has resumed operations after a shut down of several months enforced through the scarcity of crude and bad weather conditions. A pipe line is being laid by this company to the Border Field and is to be finished early in May.

New Refinery in Texas Panhandle

Navajo Refining Company has begun construction work on a 3500-barrel daily capacity skimming plant near Kings Mills, Texas, which is located between the towns of Pampa and Panhandle. The plant will process crude from this area. G. E. Quillen of Amarillo and Frank P. Jackson, representing eastern interests, organized the company, while J. D. Wrather, president of Amarillo Producers and Refiners Corporation and also Del Rio Refining Company, will supervise construction and operation. J. D. Wrather also owns an interest in the new company.

Contracts have been made for the delivery of 3000 barrels of Carson and Gray County crude daily, which comes from the properties of Dixon Creek Oil Company and Cockrell-McIlroy interests. A crude gathering systems is being installed to connect the plant with these producing properties.

Dismantling Gasoline Plant

Oklahoma Natural Gas Corporation is abandoning the last of its natural gasoline plants in the dismantling of its plant in Section 29-13-13 in Okmulgee County, Oklahoma. This company which is a larger producer and distributor of natural gas in Oklahoma was one of the pioneer manufacturers of natural gasoline in this section.

Phillips Making Gas Contracts

Phillips Petroleum Company is making gas contracts for casinghead gas with producing companies in the Judkins field, Ector County, Texas, and construction work will be started in the near future on a large natural gasoline plant. This will be the second plant for Phillips Petroleum Company in the West Texas sulphur oil district.

Special equipment will be needed in the proposed plant to cope with the high sulphur content of the gas. Producers of the gas in the Judkins field offering a recovery of more than two gallons of gasoline per 1000 cubic feet will be paid 33 1-3 per cent royalty, while that testing up to two gallons will receive 25 per cent. Since the Texas Pacific Railroad crosses the field the plant will be favored with excellent transportation facilities.

Phillips Starts Work on 46th Plant

Phillips Petroleum Company has begun construction of its 46th natural gasoline plant, which will be in the north end of the Oklahoma City pool. Producing and potential gas reserves of 700 acres have been provided for the plant. It will be of absorption type, with two distillation units. Gas capacity will be 50,000,000 cubic feet daily, under well pressure and capable of producing 35,000 gallons daily.

This plant will be a duplicate of one built earlier in the year in the south end of the pool.

Plan Canadian Natural Gasoline Plant

Research Engineering Company plans erection of a natural gasoline plant in the Turner Valley Field, Alberta, Canada, in conjunction with McLeod Oil Company. McLeod Oil Company will provide natural gas up to 25,000,000 feet daily and is to receive one-sixth of the gross proceeds from the sale of gasoline. Proceeds from the sale of the residue gas will be divided equally between the two companies. The estimated costs of the new plant is placed at $300,000.

Moves Michigan Refinery

Roosevelt Oil Company which recently purchased the refinery of Michigan Central Refining Company, Muskegon, Michigan, is moving the refinery to a new site in the Mount Pleasant field of Central Michigan according to an announcement by T. F. Caldwell, secretary-treasurer of the latter company. The Muskegon plant was shut down after operating about 45 days on storage oil. R. B. Hovis, superintendent, started dismantling April 28. Hovis will be in charge of operations under the new owners at Mount Pleasant.

Shale Plant Operating

South Manchuria Railway Company, which has had its shale oil plant under construction for the past 22 months has placed part of its facilities in operation. The plant is reported producing 1500 tons of oil with a potential of 6000 tons monthly by the middle of the year as additional unit begin operations. The shale is mined at the colliery of the railway at Fushun, Manchuria. The shale is processed with a modification of the old Scotch distillation method.

CHESTNUT & SMITH CORPORATION

Pioneer
Producers *and* Marketers

of

NATURAL GASOLINE

Always a Dependable Source of Supply

Chestnut and Smith Building

TULSA, OKLAHOMA

Two More Oklahoma Gasoline Plants Shut Down

Stebbins Oil & Gasoline Company, Tulsa, has shut down its two Oklahoma gasoline plants. The compression plant of 2,500 gallons daily capacity is in Section 17-14-16, and the absorption type plant had a rated capacity of 5000 gallons daily.

Officials of Gates Oil Company stated that their plant in Section 15-4-3 of Carter County, Oklahoma, will be dismantled. This plant has been shut down for about two years.

New Montana Refinery Building

Sterling Oil Company is building a refinery in Teton County, Montana, about two miles from Collins, which is located between Great Falls and Shelby on the Great North Railway. This plant will process Bannatyne crude. A line will be laid from the field about 10 miles to the refinery site.

Minnesota capital represented in Montana by Walter F. Brittan is financing the venture. The plant will have a daily capacity of about 700 barrels, the principle products being gasoline and fuel oil. Bannatyne production has been shut in since the discovery a few years ago, there being about 31 shallow sand wells which produce from 10 to 25 barrels each per day.

Stone Oil Operating Terminal Refinery

Stone Oil Company has taken over the refinery formerly owned by Terminal Oil & Refining Company at Texas City, Texas. This company was recently organized with R. W. Stone, president; Henry M. Stone, vice president, and R. W. Breed, secretary-treasurer.

This plant has been operated for the past 18 months under receivership and in February was sold to Mills Bennett of Mills Bennett Production Company, independent operator in the Gulf Coast territory. Mills Bennett in turn leased the plant to the Stone Oil Company. Mr. Bennett was a former owner of the plant through his interests in Terminal Oil & Refining Company. The plant is operated on Barbers Hill crude in which field Mills Bennett is a large operator and from which Liberty Pipe Line Company, a subsidiary, operates a pipe line.

The plant has a capacity of 3000 barrels, skimming, and one Jenkins cracking unit. Henry M. Stone, who has been in charge of plant operations will continue in that capacity. The plant produces gasoline, turpentine substitute, gas oil, Diesel oil and bunker oil.

New Equipment at Taxman Plant

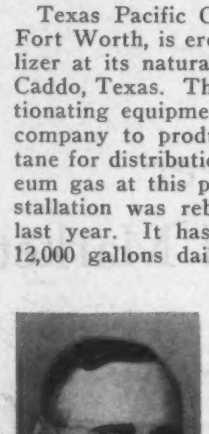
The Taxman Company, which recently took over the old Miller plant at Wichita Falls, Texas, has completed a new topping-cracking unit designed and built by Smith Engineering Company. Earl Roff, formerly construction engineer with the Smith organization has been employed to take charge of plant operations for the company.

Gasoline Plant in New Mexico Planned

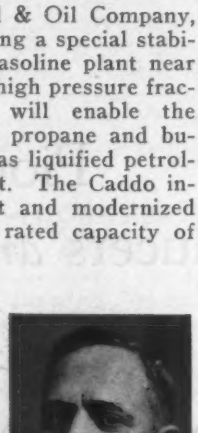
Texas Pacific Coal and Oil Company has announced that it will build a natural gasoline plant in Section 23-26 in New Mexico on its "A" lease where the company has three completed wells. The gas tests six-tenths of a gallon of gasoline per 1000 cubic feet. This will be the first gasoline plant for the Hobbs area of southeastern New Mexico.

Texas Pacific Installing Stabilizer

Texas Pacific Coal & Oil Company, Fort Worth, is erecting a special stabilizer at its natural gasoline plant near Caddo, Texas. This high pressure fractionating equipment will enable the company to produce propane and butane for distribution as liquified petroleum gas at this plant. The Caddo installation was rebuilt and modernized last year. It has a rated capacity of 12,000 gallons daily.



H. A. TROWER



F. E. RICE

C. R. MUSGRAVE

Three additional vice-presidents of the Phillips Petroleum Company of Bartlesville were elected at the annual meeting held there April 22.

Harry A. Trower is vice-president in charge of retail sales. F. E. Rice is vice-president in charge of the natural gasoline division. C. R. Musgrave is vice-president in charge of traffic.

Universal Files Four Suits

Universal Oil Products Company filed four suits against refiners charging infringement of patents on cracking which it owns, on April 11.

The defendants in these suits are the following: Standard Oil Company of New Jersey, Skelly Oil Company, Globe Oil and Refining Company, Illinois Oil Company.

Standard Oil Company of New Jersey is charged with infringing 15 patents in its operation of the tube and tank cracking process.

Globe Oil & Refining Company is sued on two grounds. Infringement is charged for the use of the Winkler-Koch and the Donnelley process, and Winkler-Koch Engineering Company is a co-dependant in this suit.

Skelly Oil Company is charged with infringing six patents owned by Universal Oil Products Company through operation of the Winkler-Koch process, and Winkler-Koch Engineering Company also is a co-dependant in this suit.

Universal Oil Products Company sometime ago obtained a judgment for infringement against Skelly Oil Company for use of the Jenkins cracking process.

All three of these suits were filed in the United States District Court of Delaware at Wilmington.

The suit against Illinois Oil Company charges infringement of six patents belonging to Universal Oil Products Company through the operation of the Donelley cracking process. This suit was filed in the United States District Court at Springfield, Illinois.

H. O. Swoboda, Inc., electrical and mechanical engineers, specializing in industrial electric heating equipment, 3400 Forbes Street, Oakland Station, Pittsburgh, has just issued Bulletin No. 190, titled "Falcon," which describes in detail the design, construction and operation of the "Falcon" straight line continuous electric furnaces for heat treating strip metal and wire. These furnaces are for shop use. The solid frame, Type F, is used for all lengths up to nine feet. The split frame, Type F, is used for all lengths from 10 to 20 feet. Maximum permissible temperature for heat treating is 1750°F. Widths of strips to be heat treated range from one to six inches and the maximum thickness of the strip is 0.050-inch. Automatic control is by pyrometer through relay and magnetic contactor, enclosed in sheet metal cabinet. Electric service is as follows: 115-230, or 440 volt, 60 or 25 cycle, single or three phase alternating current.

A copy of this bulletin will be mailed upon request to the address shown above. Other available bulletins of this company are: Bulletin No. 160, on electrically heated large asphaltum coating tanks, and Bulletin No. 170, on electrically heated compound melting tanks.

H. S. Ford, who has been connected with the R. H. Beaumont Company for the past 15 years, has resigned to become associated with the Bigelow-Liptak Corporation of Detroit. He will be located at the company's headquarters, 5057 Woodward Avenue, Detroit.

New Equipment for the Modern Plant

Grease Pump

HILLS-McKANNA COMPANY

Hills-McCanna Company, Chicago, announces a new grease pump, the Anderson mill type, which offers a fully mechanical means for pumping heavy greases and which advances another step in lubrication. It is especially made to handle high pressures and delivers measured quantities of lubricant to the surface to provide a protective film.

The grease is introduced into the feeding system of the Anderson mill type grease pump by means of a displacement pump operating a positive mechanical valve opened on the suction stroke, and closed prior to the discharge stroke. A distributor head with the requisite number of leads is directly connected to the discharge side of the pump. The indexing of the head is secured by means of a ratchet attachment which allows indexing on the suction stroke of the pump and remains fixed during the discharge stroke, after which it indexes to the next lead and continues in order.

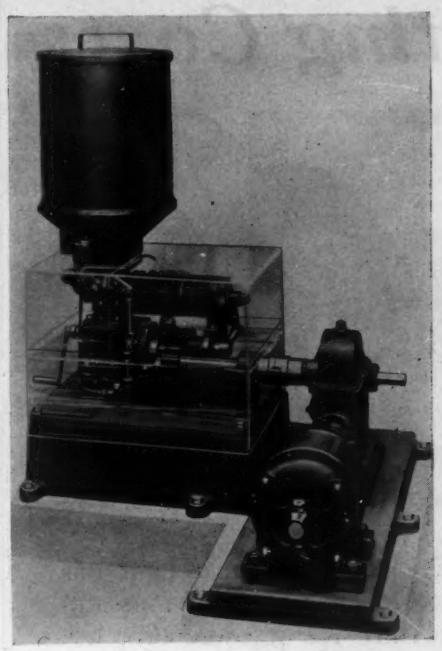
Delivery lines are attached directly to the distributor head and lead to the connections of the equipment bearings. A steam heating element is installed on the bottom of the hopper casting directly above the intake valve, to facilitate handling of heavy grease during cold weather. The grease hopper has a capacity of approximately 50 pounds. Other sizes are available on order.

A screen is installed in the grease hopper bottom beneath the steam heating element and above the intake valve to prevent foreign matter from entering the pump.

Provision is made for adjustment of the stroke of the pump to regulate the amount of grease delivery also on the speed of drive through proper adjustment of the number of teeth taken per stroke, which adjusts the delivery cycle.

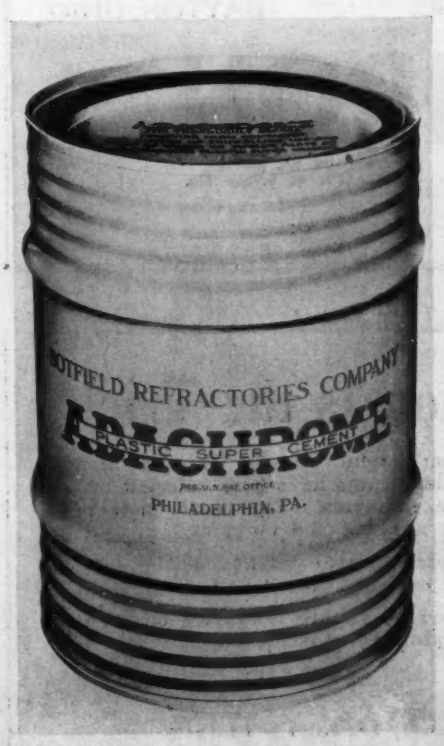
All running parts other than the motor and gear reduction unit are enclosed as a factor of safety and to protect the mechanism from dirt or scale. The entire mechanism operates in a grease or oil bath.

The Anderson grease pump is built in sizes according to the number of feeds required. Present models consist of four, six, eight, 10 and 12 feeds per unit. Special sizes are made up to 24 feeds per unit. Where more than 24 feeds or leads are needed, two or more units may be connected with a common driving mechanism to secure the desired number of feeds. The pressure capacity of the Anderson pump is sufficient to deliver grease under any bearing pressure to a maximum of 5000 pounds per square inch.



Hills-McCanna Grease Pump

Further particulars and a bulletin may be secured by writing the manufacturer, Hills-McCanna Company, 2349 Nelson Street, Chicago.



New Chromite Cement

New Chromite Cement

BOTFIELD REFRACTORIES CO.

Botfield Refractories Company, Swanson and Clymer Streets, Philadelphia, has developed a new high temperature cement which will be added to its line of Ada-products and sold under the trade name of Adachrome plastic super-cement. In this new cement, the basic material is a high-grade chromite ore obtained from South American deposits.

Because of its chromite base, Adachrome plastic super-cement is chemically-inert, and is also hard, dense and highly refractory. Furthermore, the new cement employs a bonding agent which is efficient at high temperatures.

Among the destructive furnace actions to which this new cement is resistant are basic and acid slags, molten metal penetration, abrasion, erosion and chemical reaction in the burning of acid sludge. In addition, the material, when applied as a surface coating on boiler settings, protects the brickwork from the penetrating action of clinker and fusible coal ash.

In the field of chrome cements, Adachrome plastic super-cement is sold in plastic form, ready for use without laborious mixing prior to use. The material is suited for making either dipped or troweled joints.

Another feature of the new cement is its plasticity, which contributes to ease of handling and working. The material is for laying up fire clay brick, silica brick, chrome brick, high alumina brick and also for laying up magnesite brick under certain conditions. It is also adaptable for use as a surface coating material, and as a binder in the mixture of patching materials for repairing burned-out sections of refractory construction.

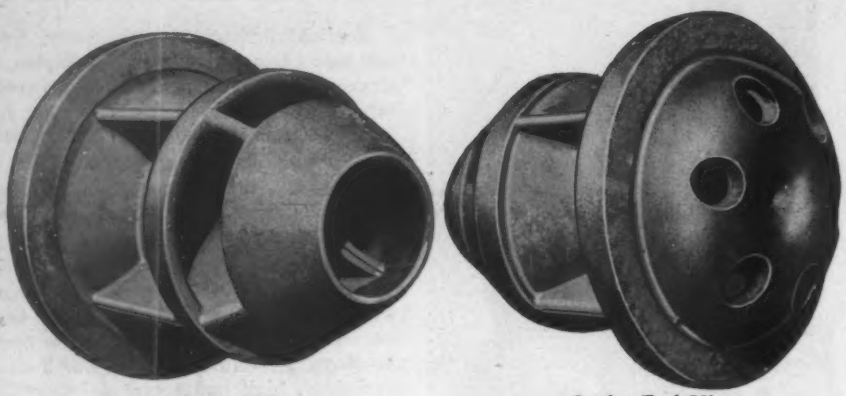
This new cement will be packed in heavy gauge metal drums with full-size openings adding to convenience of use. The drums, which are painted a distinctive yellow with red lettering, have air-tight covers that prevent waste or deterioration of the material. Two sizes of drums, 250 pound and 500 pound, are available. Complete data is offered by the manufacturer to those interested.

Welding Rod

FUSION WELDING CORPORATION

Fusion Welding Corporation, 103rd Street and Torrence Avenue, Chicago, has developed a new welding rod, Weldite C-No. 6 Fluxed, a rod designed for carbon arc welding and particularly adaptable for the welding of mild steel plates and castings. Welding speed is substantially increased as well as the strength and ductility of the deposit

Lower Your Treating Costs



Inlet End View *Outlet End View*

One acid resisting Duriron Mixing Nozzle will eliminate six or more orifice plates.

DURIRON Mixing Nozzles treat light oils and lube stock, make up emulsions and blend, with one-third the pressure drop required with orifice plates.

They eliminate maintenance expense, as Duriron is chemically inactive to the acids used in refinery processes and it is so hard that its surfaces are not scored by high velocities or gritty solutions. *In a word, these nozzles do a thorough and economical job.*

Complete data—method of installing, sizes, prices, etc.—sent on request.

THE DURIRON COMPANY, INC. DAYTON, OHIO

DURIRON
FOR ACID SERVICE

The Spiral Motion Is the Trick

That's why Hood's Chemico Spiral Packing Rings have been selected by so many engineers. The center hole prevents choking and clogging.

Made of acid-resisting shale—practically indestructible.

Used by all big producers because of the intensive movements.

Samples on request

B. MIFFLIN HOOD CO., DAISY, TENN.

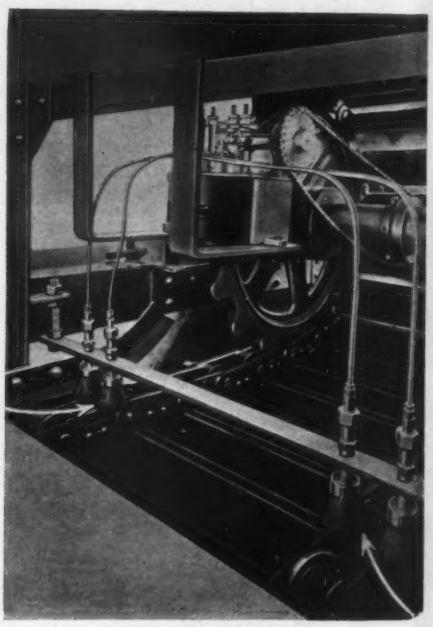
through this development. The deposit is more readily machinable than deposits made with the usual filler rod used formerly by the company.

The influence of the flux coating, causing the arc to pull from the hottest part of the weld puddle rather than jumping to the colder edges offers more ease of manipulation of the arc.

The manufacturers state that this rod is particularly adapted to foundry work due to the ductile qualities of the deposit.

Further details on this rod, and samples, may be obtained by writing the company at the above address.

Fusion Welding Corporation has recently issued a bulletin devoted to describing the Weldite line of welding rods for various lines of work. This bulletin, containing a general line of information about different types of welding jobs, is also available upon request.



Lubrication Adapter

Lubricator Adaption

HILLS-McCANNA COMPANY

Hills-McCanna Company, 2349 Nelson Street, Chicago, announces an interesting adaptation of the company's force feed lubricator to a difficult oiling problem. The accompanying photograph shows how one company is assuring lubrication of a heavy duty conveyor used for carrying filled and empty drums.

The lubricator is mounted on the under or slack side of the conveyor. Oil is forced, by the pump, to the brushes shown through a one-quarter-inch copper tubing. As each link in the chain passes beneath the brushes it is coated with a film of oil. The lubricator used on this installation is a four feed unit driven by a sprocket

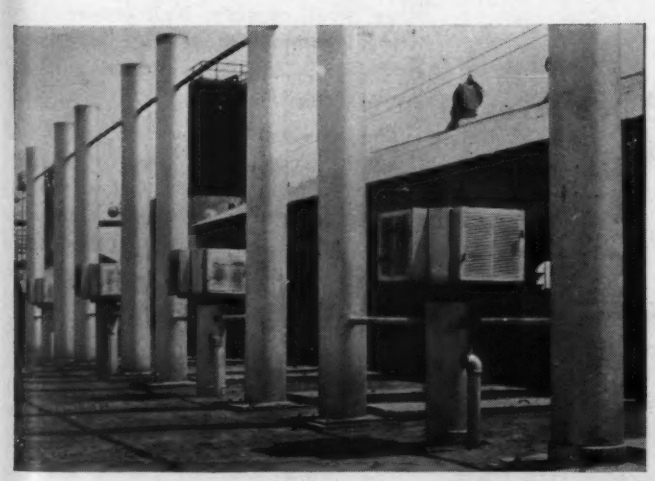
REED AIR IS *Clean* AIR

INSTALL

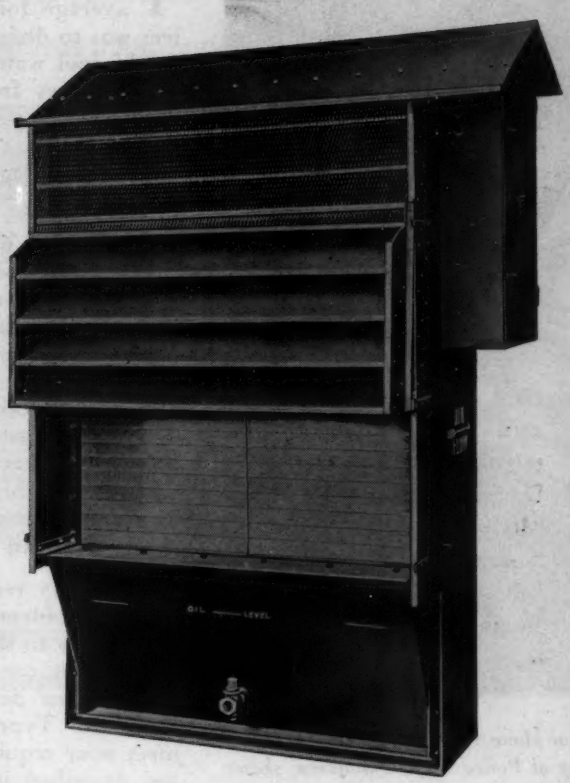
A REED AIR FILTER

For 60 days, at our risk, and prove for yourself that CLEAN AIR insures:

1. **Elimination of valve trouble.**
2. **Greatly reduced wear on clyinders, pistons and bearings.**
3. **Elimination of 90% of the trouble caused by carbon.**
4. **Greatly reduced contamination of lubricating oil.**



Above is a Reed Type SCF Filter installation for a major operating company at their compressor plant.



The illustration above shows the Reed Multi-panel Air Filter with the automatic self cleaning feature insuring continuous uninterrupted service.

Mail for Full Information

HANLON-WATERS, INC.,
Box 1404, Tulsa, Oklahoma.

Gentlemen: Please send Reed Air Filter literature.

Name .....

Address .....

Company .....

HANLON-WATERS

INC.

General Offices: TULSA, OKLA. *Box 1404*

HOUSTON FORT WORTH DENVER

An airplane view of part of a refining plant at Ponca City, Oklahoma, showing our cooling tower. This tower is 60 feet high.

Cooling Water From 150 Degrees to 74 Degrees

THE 70 degree wet bulb is the July average for Oklahoma. Our problem was to design a cooling tower which would cool water going on the tower at temperatures from 125 degrees to 150 degrees to a point within 5 degrees of the wet-bulb, cooling over a range as much as 75 degrees.

The solution to the problem was a cooling tower 60 feet high with twenty decks. That cooling tower was installed almost four years ago, and the results to date have been entirely satisfactory. Records have been kept of the daily and often hourly performance of this tower, and true wet-bulbs have been taken with a sling psychrometer as well as stationary wet-bulb readings, so that the performance of the tower has been checked in every way against the cooling results it was designed to accomplish.

Not every refining plant has a water cooling problem as hard as this. We cite this merely to show that our engineering department can handle difficult assignments when necessary. Ordinarily our Standard Type Cooling Towers will meet your requirements perfectly. They are described in our Bulletin 283-R, a copy of which will be sent on request.

THE COOLING TOWER COMPANY, INC.

15 JOHN STREET, NEW YORK

Representatives in Principal Cities

TULSA	HOUSTON	LOS ANGELES
Whealton & Townsend, Inc., 120 E. Brady St.	J. A. Rossiter Company 410 Union Nat. Bank Bldg.	N. O. Fleming 5815 Maywood Ave., Huntington Park

WALTER J. PODBIELNIAK—PAUL M. RAIGORODSKY

Consulting Engineers

PHILTOWER BLDG., TULSA, OKLA. TEL. 7264

NATURAL GASOLINE PLANT DESIGN AND OPERATION

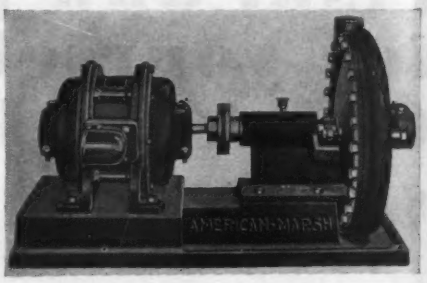
ANALYTICAL AND RESEARCH LABORATORIES

FRACTIONAL DISTILLATION ANALYSIS

and chain from one of the main drive shafts.

Units are built in several sizes, ranging from pint capacity single feed units for use on small equipment pumps and the like, to large units having as many as 60 feeds. These units may also be mounted in tandem, operated by a central driving unit, thereby increasing the number of feeds to any desired quantity. These larger units permit lubrication of several related machines at regular intervals with predetermined amounts of oil.

Further details may be secured from the manufacturer at the address given above.



American Centrifugal Pump

Centrifugal Pump

AMERICAN STEAM PUMP CO.

May Machinery Company, 2105 Second National Bank Building, Houston, representative for the American Steam Pump Company has recently announced the placing on the market by the latter company of the new American-Marsh Type Q centrifugal pump. This is a single stage, small capacity, high pressure centrifugal pump, with a range in capacity from five to 35 G.P.M. and are good for heads up to 300 feet.

The impeller has but one vane, and this vane has a knife edge for the purpose of reducing friction below that of the everage centrifugal pump. High efficiencies are strived for in the design and construction.

Ball bearings are standard equipment, and they are carried apart from the pump casing. Both the shaft and impeller are made of stainless steel. There are no close clearances at any point inside the pump casing except in the stuffing box.

The suction stuffing box is designed for easy adjustment, which, when made, restores the pump to its original status by virtue of the fact that this is the only source of leakage from the discharge side of the impeller to the suction side.

These pumps are especially adapted for use in handling light oils, circulating water and for feeding small high pressure boilers.

Bulletin No. 64 has been published, out-

HAVING GASKET PROBLEMS?

LET US SOLVE THEM FOR YOU!

We make metal gaskets of any size or shape, plain or corrugated, with or without asbestos, also plain solid washers of copper, aluminum, monel metal or any material desired. Our Gasket Guide shows a very complete line of gaskets suitable for refinery work.

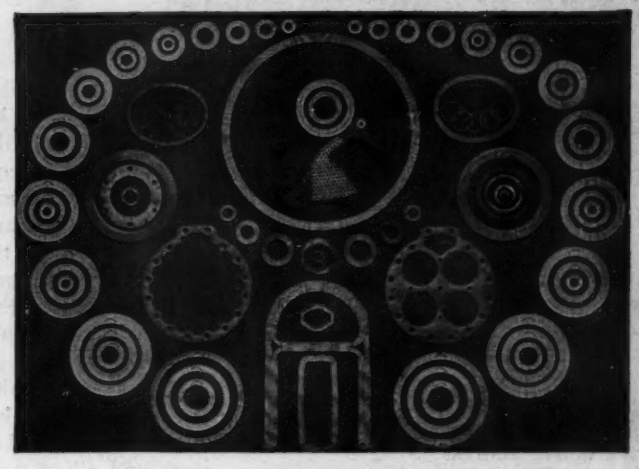
Copy sent upon request.

GOETZE

Gasket&Packing Co., Inc.

P. O. Box 175

NEW BRUNSWICK, N. J.

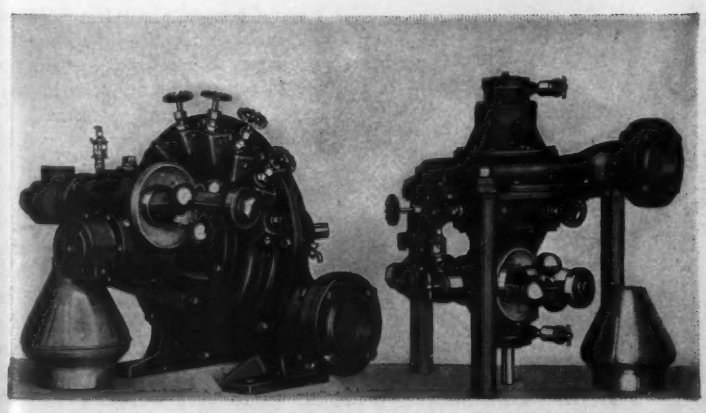


A Few Types of Goetze Gaskets

Coppus Steam Turbines

1/4 to 60 H.P.

Explosion proof . . . Easy speed control . . . Rugged, reliable and low priced . . . Best steam economy . . . giving power without cost when used as "reducing valve" for heating or process work . . . Exhaust steam free from oil.



Horizontal **Vertical**

Read bulletin 135

Coppus Engineering Corporation

360 Park Ave., Worcester, Mass.

lining the pumps in pictures and detailed description. This bulletin is available upon request to the May Machinery Company or to the manufacturers, American Steam Pump Company, Battle Creek, Michigan.

Gas Filter

REED AIR FILTER COMPANY

Reed Air Filter Company, Louisville, Kentucky, has placed on the market a new gas filter for cleaning natural gas before it enters compressors. Entering gas is deflected downward where it is brought in close contact with oil in the bottom of the tank, and a large percentage of heavy dirt such as sand and pipe scale is caught in the oil. Gas then passes through a regular Reed filter cell, identical in construction to the Reed filters. Any remaining dirt is caught in this filter cell.

The Reed gas filter has been designed by the manufacturer to remove from 97 to 99 per cent of all solid impurities in the gas. One of the features of this filter is its long life of usefulness due to its ability to prevent a large percentage of dirt from entering the cell.

The Reed gas filter is offered in two sizes. Type "A" with a capacity of 1,150,000 cubic feet of gas and type "B" with a capacity of 1,750,000 cubic feet, per 24-hour period.

For information write the company at the above address.

Magnetic Switch

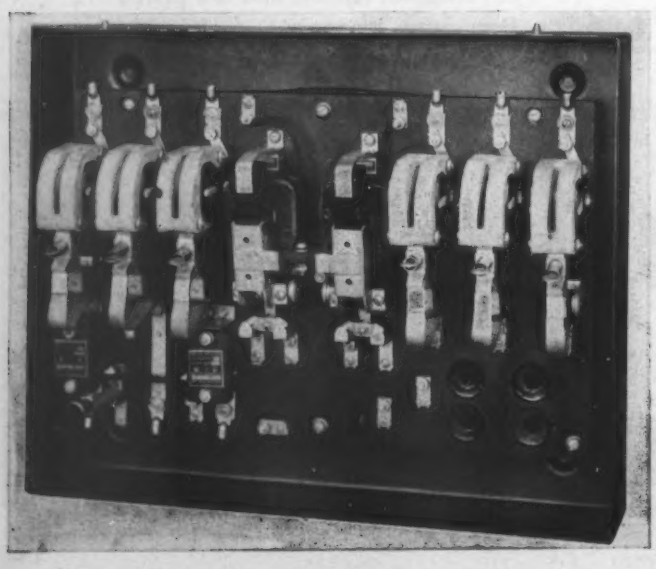
GENERAL ELECTRIC COMPANY

General Electric Company has announced a new enclosed, magnetic, reversing switch, the purpose of which is to control motors of greater horsepower than those controlled by the superseded type. This switch, designated CR-7009-B-18, supercedes the CR-7009-5 switch of the same type.

The new device is designed to throw small alternating-current motors directly across the line. It consists of two triple-pole, mechanically interlocked, magnetically operated contactors with restricted-type blowouts, and with a normally-open interlock on each contactor. It also has two hand-reset temperature overload relays. The contactors are mounted side by side on a molded base, instead of back to back as in the previous design. The device, which is illustrated here, is contained in a drawn-shell steel enclosing case.

Maximum horsepower ratings of the new switch are as follows:

Volts	3- & 2-phase 3- or 4-wire	Single-phase
110	7½	3
220	15	7½
440	15	10
550	15	10
600	15	10



G-E Magnetic Reversing Switch

The J. A. Campbell Company, Long Beach, California, has just published a new catalog describing the entire line of gasoline plant equipment. This catalog outlines some of the modern methods of shop and erection practice making possible the construction of complete and permanent plants in from 25 to 35 days. Full descriptions are given of the various units employed in Campbell gasoline plants, including absorbers, cooler units and towers, heat exchangers, pre-heaters, distillation systems, boiler plants, pumps, stabilizers and allied type of equipment, all of which are automatic in operation. Engineers in the petroleum industry will be mailed a copy of this catalog upon request to the company.

Brown Instrument Company has just issued an interesting and instructive booklet, "Applying Temperature Control to Oil Refining," by R. D. Bean, manager of engineering development. This booklet, which comprises 21 pages and five full page illustrations of typical chart records, discusses the various temperature control problem encountered in refining practice, together with the types of control equipment available, in interesting detail. The discussion is of interest to both the practical oil man and to the technologist. It clearly indicates the curate temperature importance of accontrol and the various elements which must be considered in connection with the choice of the necessary equipment. Tower, furnace and hot oil control are discussed at some length.

Copies of this booklet will be mailed upon request to Brown Instrument Company, Wayne and Roberts Avenue, Philadelphia.

Ludlum Steel Company, Watervliet, New York, is furnishing its 1930 literature, including a catalog, a reference book and a booklet on tool steel, in a handsome loose-leaf binder for the convenience of its customers. The catalog covers the company's line of high speed carbon and alloy tool steels, corrosion, heat and wear-resisting steels, valve steel and Strauss metal. The tool steel booklet devotes 48 pages to discussions and tables on high speed special alloy carbon steel for special purposes. The third book is a reference book of steel treating tabulations.

Crocker-Wheeler Electric Manufacturing Company has published a four-page folder which is devoted to outlining the performance of the company's motors for direct current adjustable speed. A copy of this folder is available by writing the company headquarters at Ampere, New Jersey, or to a branch office of the company.

American Blower Corporation, Detroit, Michigan, has just issued Bulletin No. 9218, describing the Venturafin method of heating for floor, wall or ceiling mounting. The bulletin is available upon request. This bulletin supersedes Bulletin No. 7818.

The R. Y. Ferner Company, exclusive representatives in the United States and Canada for Chevenard dilatometers and industrial thermic analysers, with headquarters in the Investment building, Washington, D. C., has published Catalog D-1, a 16-page layout covering the design, construction and operation of these products. It is available upon request to the company.

Phoenix Manufacturing Company, recently announced the purchase by this company on May 1 of Graver Corporation's steel tank, water treating and steel plate construction business, including the plant at East Chicago, Indiana. The purchaser will operate this plant and business under a wholly owned subsidiary company, Graver Tank & Manufacturing Corporation.

The East Chicago plant has a fabricating capacity of more than 40,000 tons of steel per year. Phoenix Manufacturing Company has three plants located at Catasauqua, Pennsylvania; Montreal, Canada, and Joliet, Illinois, which combined have a capacity of more than 30,000 tons of iron and steel products per year.

The new company will maintain branch sales offices at 28 East Jackson Boulevard, Chicago, at New York, Dallas, St. Louis, San Francisco and several other centers. The general office will be at East Chicago. Officers of the new company are: Edward N. Gosselin, president; R. E. Meyer, secretary and treasurer; F. C. Everitt, vice president and general manager; P. S. Graver, vice president in charge of sales, and W. F. Graver and H. S. Graver, vice presidents.

Waterous Rotary Pumps

Why use a Waterous Rotary Pump? Because it combines the advantages of both the Centrifugal and Piston types. It is free from valves, pistons and crank shafts, is self-priming, and has a uniform efficiency over its entire pressure range. Quite naturally the industrial field was quick to recognize the worth of such a pump. Its popularity is growing steadily.

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ITEMS ABOUT MANUFACTURERS

Barrett, Haentjens & Company, Hazleton, Pennsylvania, has recently issued Bulletin No. 501 on centrifugal pump accessories and centrifugal pump priming, with notes on the theory of suction lift, suction losses, etc. It is a loose-leaf bulletin, illustrated, and is available by writing the company at Hazleton.

Bailey Meter Company, 1050 Ivanhoe Road, Cleveland, announces that it has transferred its office in Chicago, to 20 North Wacker Drive Building. R. V. Knapp continues as branch manager in this territory where he is assisted by a staff of mechanical engineers specializing in metering control and combustion problems.

Neilan, Schumacher & Company, manufacturers of control equipment, are building a new and larger experimental laboratory at their factory, located at 641-651 Santa Fe Avenue, Los Angeles. When the new laboratory is finished and equipped, the company's present modern laboratory will be used only for testing and adjusting control equipment to prior shipments, it is understood, and the new laboratory, now nearing completion, will be used exclusively for experimental research and development. Every piece of Neilan control equipment is tested throughout its pressure range, under actual working conditions and by experienced engineers, before being shipped from the factory.

Walworth Company, 60 East 42nd Street, New York City, announces the establishment of a new sales office in Houston, under the management of W. C. Goza, who was formerly the company's Western division sales manager with headquarters at Kewanee, Illinois. He will work in connection with the distributors of Walworth products in the Southwest. The routine work of making quotations, handling orders and correspondence concerning oil country business will continue to be done at Kewanee under Goza's direction. He is succeeded as sales manager of the Western division by Charles W. Watson, excepting Oklahoma and Texas. The latter's office will be at 231 South LaSalle Street, Chicago.

Struthers-Wells Company, Warren, Pennsylvania, now has its Chicago office in the new Civic Opera Building, 20 North Wacker Drive.

C. J. Tagliabue Manufacturing Company, Brooklyn, New York, will move about July 1 from its old location at Bush Terminal to the new quarters shown here, located at Park avenue, extending from Nostrand avenue to Sanford street.

This move represents an expansion to more than double the present facilities in manufacturing and distributing. The new building provides approximately 300,000 square feet of working floor space. Near the executive offices on the third floor is provided a large reception room and show room where the company's products will be on display. A completely equipped hospital is to be conveniently located on the first floor, easily accessible to the entire plant.

C. J. Tagliabue Manufacturing Company manufactures a line of instruments, including indicating, recording and controlling instruments for temperature, pressure, humidity, time, condensation and liquid level, laboratory and industrial thermometers, hydrometers and oil testing instruments.

Connersville Blower Company, Inc., of Connersville, Indiana, has moved its Chicago sales office to Room 1428, No. 20 Wacker Drive. Effective May 1, the New York sales office of the company will be located at Room 533, Graybar Building, 520 Lexington Avenue.

Northern Equipment Company, Erie, Pennsylvania, has recently published two folders, one describing Copes Type DS pump governor, and the other telling the story of the Copes Type RG feed water regulator for controlling both differential water pressure and the amount of flow. Aside from a detailed description, with photographic and mechanical drawing illustrations, the folder on Type RG regulators gives a detailed outline of the application and operation. Either or both of the folders are available upon request to the company.

Leeds & Northrup Company, 4901 Stenton Avenue, Philadelphia, has issued Bulletin No. 660, which is No. 6 of a power plant series, covering metered combustion control for boiler furnaces. This bulletin carries in folded form a reproduction of a Leeds & Northrup Company carbon dioxide chart taken on a boiler equipped with a Leeds & Northrup automatic combustion control. The bulletin, fully illustrated, outlines the principle of the company's metered control, covers fully the control of stoker fired furnaces, control of powdered fuel furnaces and other subjects of interest to engineers.

Bullard-Davis, Inc., manufacturer and distributor of safety equipment, has been joined at its Houston office by H. J. McCants, formerly assistant safety director for Gulf Refining Company at Port Arthur. J. J. Delahide is in charge of the Houston office which has recently been moved to 510 McGowan Avenue.

Naylor Pipe Company, Chicago, announces the removal of its New York City office from 25 Church street to new quarters at 3116 Chrysler Building, Lexington avenue and 42nd street.

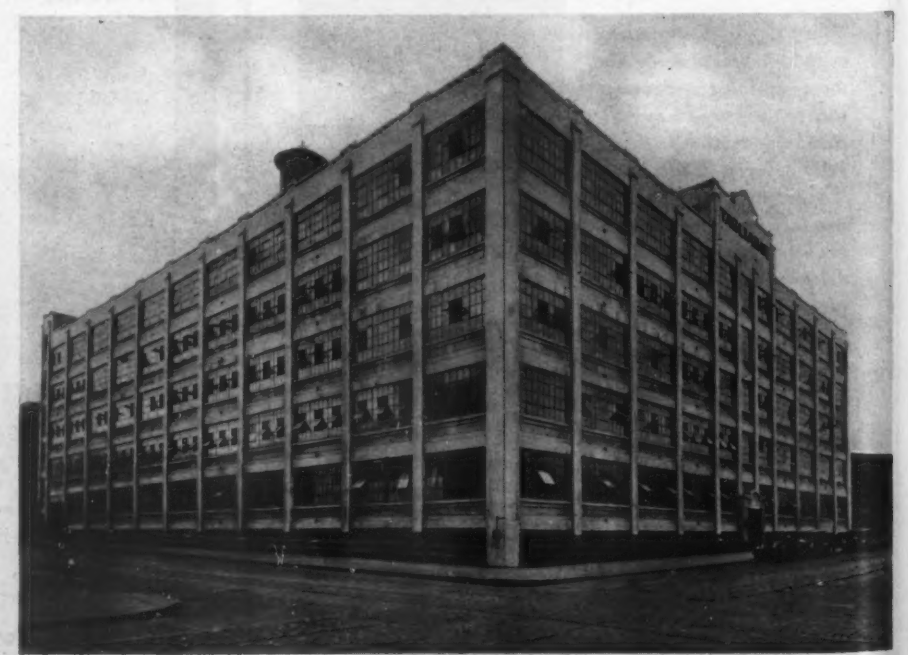
Tube Turns of Louisville, Kentucky, has announced the appointment of Patrick H. Heeney, Apartado 298, Maracaibo, Venezuela, S. A., as distributor for the company in South America.

Central Alloy Steel Corporation, Massillon, Ohio, has announced that the Wyatt Metal & Boiler Works of Dallas and Houston will henceforth fabricate corrugated culverts of genuine Toncan copper Mo-lyb-den-um iron, No-Co-Ro copper iron, and U-loy copper steel.

Lincoln Electric Company, Cleveland, Ohio, announces the transfer of three men from the manufacturing district to the welder service division as follows: John C. Ardagh has gone to the Chicago district with headquarters in the Monadnock building, Chicago. R. A. Kyle has gone to the New York district with headquarters at 136 Liberty street, New York City. Robert Newton has gone to the Cleveland district with headquarters at the factory in Cleveland.

E. D. Bullard Company, 275 Eighth Street, San Francisco, announces the purchase of the First Aid Equipment and Supply Company, of Los Angeles. This company has offices in Los Angeles, Seattle, Salt Lake City and Houston.

Republic Steel Corporation, through H. T. Gilbert, vice-president in charge of sales, has announced the following executive sales appointments: A. E. Walker, former general sales manager of Republic Iron and Steel, becomes assistant vice-president. J. M. Schlendorf, formerly vice-president in charge of sales of Central Alloy Steel, will assume the duties of sales manager of Alloy Steel Products. Norman Foy, Birmingham district manager in the old Republic organization, becomes sales man-



New Location of C. J. Tagliabue Manufacturing Company

EMPIRE OIL METERS

The EMPIRE Oscillating Piston Meter is the best and most convenient instrument procurable for accurate measurement of oils, gasoline, and other liquid petroleum products. It has no equal for pressure still work, and all other measuring requirements of the refinery. EMPIRE meters are made in all sizes, from 5/8 to 6 inches, inclusive. Standard types will withstand a pressure of 150 lbs. to the square inch. High pressure types will handle up to 300 lbs. Meters for still higher pressures, and special types for special purposes will be built to order. The vertical dial as shown here, can be turned to face in any one of four directions. The hands can be set back to zero after any single run without disturbing the total of all the runs, which is recorded on a straight-reading register in the lower part of the dial face. Standard horizontal, straight-reading registers can be furnished if preferred.

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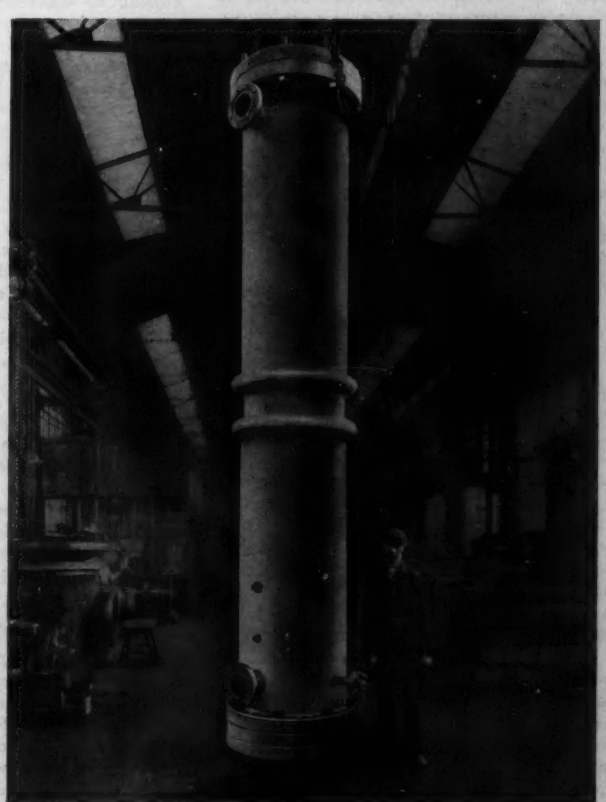

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ager of Mild Steel Products, with headquarters at Youngstown, Ohio. Mr. Gilbert states that coordination of the various sales units is proceeding rapidly and will be completed shortly. Harry Rhodehouse has been appointed general traffic manager of Republic Steel Corporation, having held a similar position with the old Republic Iron and Steel Company. W. H. Ohl has been made comptroller of the new corporation after having served the old company in that position.

Goulds Pumps, Inc., Seneca Falls, New York, has appointed B. F. Barnett as acting manager of the Houston office of the company located at 1902 Second National bank building, to take the place of H. G. Garnsey, who came to Houston from the factory to serve as acting manager after the recent death of E. G. Goddard. Barnett's territory includes all of Louisiana, Texas outside of the Panhandle and extreme north portion, and southeastern New Mexico.

Industrial Chemical Sales Company, Inc., 230 Park Avenue, New York City, has issued a new brochure titled "Activated Carbon—The Modern Purifier." This brochure contains considerable subject matter of interest to refinery chemists, who will be mailed a copy upon request to the above address.

Terry Steam Turbine Company, Hartford, Connecticut, announces the appointment of T. G. Hart to the position of general sales manager. He has been associated with this company since 1919, and for several years has been manager of the Chicago office. In the future he will be located at the home office and works of the company.

Wagner Electric Corporation, 6400 Plymouth Avenue, St. Louis, announces the addition of Albert Shaw, a mining engineer, to its Salt Lake branch office sales force. Shaw was educated and received his early field experience in Scotland. In 1920 he came to the United States and joined the United States Geological Survey.

A. P. Green Fire Brick Company, Mexico, Missouri, has issued an attractive booklet in which the properties of the company are shown. The story of the processing, from obtaining of the raw material until the turning out of the finished product, is told in pictures. Working methods in the manufacture of these fire brick are outlined with photographs of each working stage. In 43 centrally located cities, including the United States and foreign countries, complete stocks of Sairset and Quikpatch are carried for installation under the direction of trained men. The company stocks its products in more than 250 towns and cities for handling by dealers in less than car-lot shipments.

C. H. Wheeler Manufacturing Company of Philadelphia has recently published and is mailing out a 132-page book titled "Steam Condensers." This book, handsomely compiled and bound, discusses in detail "Elements of the Condensing Process," "Economics of the Condensing Process," "Jet Condensers," "Surface Condensers," "Condensing Equipment Auxiliaries," "Condensing Equipment Accessories," and "Properties of Saturated Steam." It is fully illustrated. Persons interested in securing a copy should communicate with the company's Philadelphia headquarters.

Allied Construction & Engineering Company has been incorporated with offices at 604 National Bank of Commerce Building, Tulsa, to engage in engineering, design and construction of works allied with the refinery, pipe line, gasoline, marketing and production operations of oil companies. M. A. Rutis, F. E. Richardson, W. C. Ray and A. W. Rush are included in the company.

W. S. RUGG

Westinghouse Electric & Manufacturing Company, East Pittsburgh, has placed W. S. Rugg formerly vice president in charge of engineering, in charge of sales activities in addition to his engineering activities. By this appointment Rugg takes over the activities of Edward D. Kilburn, vice president and general sales manager, who resigned, effective April 16. S. M. Kintner, director of the company's research laboratories, has been made assistant vice president, and takes over the engineering duties under Rugg's direction.

W. S. Rugg has been associated with the company since 1892. Following engineering and sales work in the Chicago territory, he was transferred in 1909 to New York in charge of that office. In 1917 he was moved to the East Pittsburgh office, and was made general sales manager in 1922, and was elected vice president in 1925.

L. V. MCANELLY

Standard Oil Company of New York City, has appointed Lee V. McAnelly sales representative of the Paint Department of the company with headquarters at Beaumont, Texas. McAnelly is well known in the supply branch of the oil industry through his former connection with Rossendale - Reddaway Belting Company.

International Machine Tool Company, Indianapolis, Indiana, has published literature covering Libby International turret lathes, including an eight-page bulletin for insertion in a loose-leaf catalog, and two folders. Illustration descriptions of each individual type manufactured are used, and will be mailed to interested persons upon request to the headquarter office.

American Viscosimeter Company, Inc., New York, a subsidiary of General Motive Control, Inc., has appointed James C. Elverson general manager. Elverson has been associated with Motometer Company, New York, as general manager of the industrial division since 1920. American Viscosimeter Company, Inc., manufactures and distributes an instrument for determining the condition of lubricating oil in engines.

C. F. Pease Company, 813 North Franklin Street, Chicago, has made C. D. McCornick, formerly assistant advertising manager, advertising manager to succeed W. Earl Pashley, now second vice president and assistant sales manager. McCornick has been with this company for more than four years, and was previously connected with Illinois Glass Company, Alton, Illinois.

Ludlow Valve Manufacturing Company, Troy, New York, announces the election of James H. Caldwell as chairman of the board of directors. Mr. Caldwell has been general manager of the company for 41 years, 27 of which he was also president. He has served as president of the Waterworks Manufacturers' Association and has been chairman of the flange standardization committee of the Valve Manufacturers' Association.

William H. Lolley, a director and general manager of Ludlow Valve Manufacturing Company, has been elected to succeed Caldwell as president.

Ludlow Valve Manufacturing Company has

WANTED — EXPERIENCED MECHANICAL ENGINEER

for construction and maintenance in 15,000 barrel Oklahoma refinery. Married graduate preferred. Give full details and snapshot in first application. None other will be considered.

Address Box 1451, care Refiner and Natural Gasoline Manufacturer, Houston, Texas.

WANTED

Graduate chemist or chemical engineer by Mid-Continent Refiner for laboratory and plant development. Must have thorough training in chemistry and experience in testing petroleum products. Give full details concerning age, education, experience, salary expected, snapshot of self and references in application, otherwise will not be considered. Address Box 6057, care Refiner and Natural Gasoline Manufacturer, Houston, Texas.

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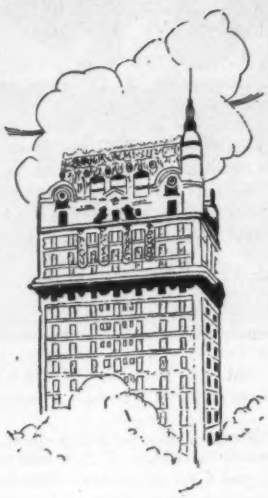

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Natural Gas is an IRRESISTIBLE bargain for industry. And the family ice box runs with the same spotless, automatic, economical heat that runs the oil refinery.

By the way, have you SEEN the Gas Refrigerator? It is the simplest chilling method, next to Jack Frost himself. No machinery. No noise.

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Producers and Transporters of Natural Gas

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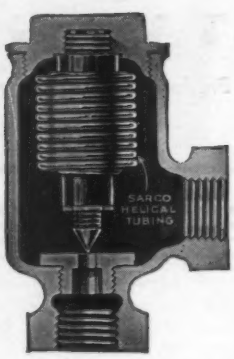
A Steam Trap is a Traffic Cop!



The purpose of a steam trap is to clear the road of condensate so steam can have free passage—just as a traffic cop clears the road for cars.

Some folks seem to think the bigger a trap is, and the more condensate it holds before dumping it, the better the trap must be. But why pay three times as much for a big trap just to get "parking space" for condensate, when the Sarco says "GO" as soon as any condensate collects?

There is never any block against oncoming steam with a Sarco Steam Trap. It returns condensation to the hot well as soon as it collects, and while still hot, so you don't need so much coal to turn it back into steam.

And that's true whatever the pressure from 0 to 100 lbs., because this trap is self-adjusting.

Little! Yes, but that is its big point. The Sarco is small enough to go where the big fellows won't fit. It is so small that you don't have to dig any pits or build any platforms. Screw it into the pipe line and you're through.

We'll send you a sample on us, for a month. Return it if you don't like it and we will not charge you for the trial. More than a half million have gone out on that offer and we couldn't have stayed in business all these years if they hadn't made good. Use the coupon—that's what it's there for.

SARCO CO., Inc.
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Boston Chicago Detroit Pittsburgh
Buffalo Cleveland Philadelphia St. Louis
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SARCO CO., Inc.,
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New York, N. Y.
☐ Send a Sarco Steam Trap on 30 days' free trial as follows: Size.....
for pressure .....lbs.
☐ Send Booklet No. S-95.
Firm .....
Street .....
City .....State .....

recently acquired additional ground and contemplates an increase of production facilities at an early date as part of a program of expansion, diversification of products and general development. The company was organized and started business in 1866. During the first 30 years three programs of expansion were made, and the present location was taken up in 1897. Since that time continued expansion has taken place in the headquarters office, foundry and machine shop.

Neilan, Schumacher & Company announces the appointment of Eldridge V. Weaver as sales representative for the North Texas territory for Neilan regulating and control equipment with Dallas as headquarters. Roy O. Campbell, former North Texas representative for the company, has been made Mid-Continent factory representative.

Stockham Pipe & Fitting Company announces the appointment of Germer Petesch as assistant general sales manager, with headquarters in Birmingham, Alabama, the home of the company. He has long been connected with the company, and was formerly Chicago manager for Stockham Pipe & Fittings Company.

The Elliott Company, Jeannette, Pennsylvania, has announced a change in the address of its New York and Chicago offices. The New York office is now located in larger quarters at 2905 Transportation building, 225 Broadway. The new location of the Chicago office is 1534, 20 North Wacker Drive.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

Of The Refiner and Natural Gasoline Manufacturer published monthly at Houston, Texas, for April 1, 1930.
State of Texas, County of Harris:

Before me, a Notary Public in and for the State and county aforesaid, personally appeared A. L. Burns, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the The Refiner and Natural Gasoline Manufacturer, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:
Publisher: R. L. Dudley, 3238 Huntington Drive, Houston, Texas.
Editorial Director: S. W. Robinson, 5002 Scotland Ave., Houston, Texas.
Editor: Grady Triplett, P. O. Box 562, Tulsa, Okla.
Managing Editor: J. Kent Ridley, 4401 Grecly, Houston, Texas.
Business Manager: A. L. Burns, 4311 San Jacinto, Houston, Texas.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)
The Gulf Publishing Company ,Houston, Texas; James Anderson, Houston, Texas; R. L. Blaffer, Houston, Texas; Mrs. Sarah Campbell Blaffer, Houston, Texas; A. L. Burns, Houston, Texas; J. F. Carter, Jr., Tulsa, Oklahoma; Dr. N. L. Dudley, Goose Creek, Texas; R. L. Dudley, Houston, Texas; W. S. Farish, Houston, Texas; Wm. V. Gross, Houston, Texas; Howard R. Hughes, Houston, Texas; Chas. H. Lane, Houston, Texas; J. H. McEvoy, Houston, Texas; Wallace E. Pratt, Houston, Texas; J. Kent Ridley, Houston, Texas; S. W. Robinson, Houston, Texas; R. S. Sterling, Houston, Texas; O. R. Waller, Chicago, Illinois.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)
Houston National Bank, Houston, Texas.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

A. L. BURNS,
Business Manager.

Sworn to and subscribed before me this 7th day of April, 1930.
(Seal) J. KENT RIDLEY
(My commission expires June 1st, 1931)